AMBER model 5500

PROGRAMMABLE AUDIO MEASUREMENT SYSTEM

OWNER'S MANUAL

SECTION 3

PROGRAMMING INFORMATION

Issue 07 January 1989

3.1 COMMAND USAGE

3.1.1 FRONT PANEL SYNTAX

DOCUMENTATION CONVENTIONS

The front panel keys are referred to in the following documentation by their associated labels on the front panel shown in bold sans serif type. Examples are **FREQUENCY** and **WIDE BAND**. References may also be prefixed by an additional label which describes a distinct set of keys on the front panel, for example, -OUTPUT-**ON/OFF**.

Although it isn't apparent in the documentation, green labelled functions are always accessed by a shift of the associated key, for example, amplitude display units are selected via the **UNITS** key while linear and log amplitude display formats are selected via the **LOG/LIN** key which, in effect, refers to the **UNITS** key shifted. The green **SHIFT** key must be depressed and held while pressing the desired key.

FRONT PANEL FUNCTION KEYS:

Key Reference: Documentation Section References:

UNITS	3.5.4 Amplitude Display Units & Operating Mode
LIN/LOG	3.5.3 Amplitude Display Lin/Log Format
RELATIVE	3.5.1 Relative Mode

- FUNCTION -

WIDE BAND	3.3.1 Measurement Type
DC	3.2.16 DC Volts Measurement Mode
NARROW BAND	3.3.1 Measurement Type
PZ	3.2.19 Phase Measurement Mode
THD	3.3.1 Measurement Type

IMD SMPTE	3.3.1 Measurement Type
IMD CCIF	3.3.1 Measurement Type

- FILTERS -

HP 400Hz	3.2.11 High Pass Filter
AUX 1	3.2.10 Weighting Filters
LP 30kHz	3.2.10 Weighting Filters
AUX 2	3.2.10 Weighting Filters
LP 80kHz	3.2.10 Weighting Filters
AUX 3	3.2.10 Weighting Filters
SPCL	3.2.10 Weighting Filters
AUX 4	3.2.10 Weighting Filters

- DETECTOR -

DET	3.2.13 Detectors

- INPUT SELECT -

A	3.2.1 Input Select
B	3.2.1 Input Select
OSC A	3.2.1 Input Select
OSC B	3.2.1 Input Select

- INPUT TERMINATION -

100 k	3.2.2 Input Termination
600/150	3.2.2 Input Termination

- PARAMETER -

FREQUENCY	3.4.3 Source Frequency 3.1.5 Numeric Entry and Modification Mode
FREQUENCY INCREMENT	3.1.5 Numeric Entry and Modification Mode
AMPLITUDE	3.4.1 Source Amplitude 3.1.5 Numeric Entry and Modification Mode

AMPLITUDE INCREMENT	3.4.2 Source Amplitude Increment 3.1.5 Numeric Entry and Modification Mode
IMD LOW FREQUENCY	3.4.5 IMD Offset Frequency 3.1.5 Numeric Entry and Modification Mode
RELATIVE REFERENCE	3.5.2 Relative Mode Reference 3.1.5 Numeric Entry and Modification Mode
- INCR -	
UP	3.1.5 Numeric Entry and Modification Mode
DOWN	3.1.5 Numeric Entry and Modification Mode
- OUTPUT -	
ON/OFF	34.7 Output Enable
A/B/-B	3.4.11 Output Configuration
- OUTPUT CONFIGURATION -	
Rsource	3.4.9 Output Impedance and Structure
GND/FLOAT	3.4.8 Output Reference
- SERIAL INTERFACE -	
SERIAL INTERFACE	3.9.1 Serial Port Usage
- GPIB INTERFACE -	
LCL	3.8.2 Selecting Local/Remote Operation
- SWEEP -	
ENABLE	See 054 manual

NUMERIC KEYS AND TERMINATOR KEYS

Numeric key closures are echoed on the frequency display. Once numeric entry is started, only DATA ENTRY (excluding **CURRENT VALUE**) and terminator keys are allowed; use of any other key will prematurely terminate the entry and cause an "Invalid Terminator" (error 5) to be generated. Numeric entry can be validly terminated by one of the terminator keys, labelled UNITS, MEMORY, and SPCL FUNCTION. Once correctly terminated, the currently selected frequency display is restored.

CLEAR aborts the current entry while **NEG** changes its sign. **CURRENT VALUE** enters the last measured amplitude, distortion, or frequency, depending on the currently selected numeric entry parameter, and doesn't need to be terminated.

The context of any value entered is determined by the currently selected numeric entry mode and the choice of terminator. If one of the -UNITS- keys is entered as terminator, the entered value is interpreted as the newly selected Source Frequency or Amplitude, IMD Frequency, Reference or Increment setting depending on which parameter was last selected. The -UNITS- keys themselves are context dependent so that if the **kHz/dBm** key terminates the entry and the currently selected numeric entry parameter is a frequency type, as for example Source Frequency, the entered value will be presumed to be in kHz. Refer to 3.1.5 Numeric Entry and Modification Mode. If one of the -MEMORY- keys, **RECALL** and **STORE**, is used to terminate an entry, the numeric value will be interpreted as the specification for a Recall or Store Machine State command. Refer to 3.7 Command Functions - Store and Recall of Machine Status. If the **SPCL FUNCTION** key is used to terminate an entry, the entered value will be interpreted as the special function number and operand. Refer to 3.1.4 Special Functions.

REPEAT KEYS

Holding any front panel keys, except those labelled -PARAMETER- and -INCR-, will have no effect on the instrument other than slowing it down while it processes the input.

Holding one of the -PARAMETER- keys will enable a temporary display of that parameter's current programmed setting. If either the **FREQUENCY,** the **FREQUENCY INCREMENT**, or the **IMD* LOW FREQUENCY** key is held, the current programmed Source Frequency, Source Frequency Increment or IMD* Frequency setting will be displayed on the frequency display. Similarly, if either the **AMPLITUDE**, the **AMPLITUDE INCREMENT**, or the **RELATIVE REFERENCE** key is held, the current programmed Source Amplitude, Source Amplitude Increment, or Relative Reference setting will be displayed on the amplitude display. In the case of Relative Reference, if a distortion type measurement is currently selected, then the distortion reference will be displayed, otherwise the level reference will be displayed. In all cases once the held key is released, the last selected front panel display mode is restored.

Holding the **UP** key or the **DOWN** key will increment or decrement the currently selected numeric entry parameter, if applicable, by the current Increment setting at a rate of 2 to 3 times a second. This is true only if the currently selected numeric entry parameter is Source Amplitude, Source Frequency, or SVF Frequency and the associated Increment parameter setting is non-zero. Attempting to increment or decrement any other parameter will cause "Unrecognized Command" (error 2) to be generated. Refer to 3.1.5 Numeric Entry and Modification Mode.

*NOTE: IMD function requires option 002, IMD.

LOCAL LOCKOUT

If the instrument is in Remote mode, only the -DATA ENTRY-**CLEAR** key, in its triggering capacity, and the -GPIB INTERFACE-**LCL** key are functional. If the instrument is in Remote With Lockout mode, none of the front panel keys are functional. Refer to 3.8.2 Selecting Remote/Local Operation and 3.8.3 Local Lockout.

3.1.2 GPIB COMMAND SYNTAX

All GPIB command and terminator mnemonics consist of 2 ASCII characters, a letter followed by a letter or number. Refer to 3.12.2 for a list of valid GPIB mnemonics. If the GPIB device is configured to respond to data messages (see Section 3.8, page 3-93), it will accept all variable length ASCII strings made up of valid command mnemonics and numeric strings delimited by terminator mnemonics (e.g. IO2.5VL). A command string may contain any ASCII alphanumeric characters, as well as the following special characters: '+', '-', '.', space, carriage return, and line feed. If any characters other than those specified above are detected in the input string, an 'Invalid GPIB Command Input' error will be generated and the processing of the current command will be aborted.

Valid numeric strings are of the form
SD.DDDDESDDTM where:

S refers to '+' or '-' sign which may be omitted, in which case, a positive value is presumed.

D.DDDD refers to a mantissa made up of up to 20 ASCII digits and a decimal point which may be anywhere in the string or may be omitted, in which case, a decimal point at the extreme right is presumed.

ESDD refers to an exponent (base 10) which must be preceded by 'E', may include a '+' or '-' sign or no sign in which case a positive value is presumed, and up to 2 ASCII digits. If the exponent is altogether omitted, an exponent value of 0 is presumed.

TM refers to terminator. Following is a list of valid terminator mnemonics:

MNEMONIC	FUNCTION
DB	dB units
DM	dBm units
DV	dBV units
HZ	Hz units
KH or KZ	kHz units
MV	mV units
PE	% units
VL	V units
UV	μV units
RC	Recall command (refer to 3.7.2 and 3.7.3)
SP	Special command function (refer to 3.1.4)
ST	Store command (refer to 3.7.1)

3.1.3 SERIAL PORT COMMAND SYNTAX (requires option 232, Serial Port)

All references to the serial port or terminal CRT are to be taken as synonymous.

Serial port commands are entered as follows: command **operand operand** or numeric-string terminator. In the latter case the numeric string and terminator are used with the current numeric entry mode (N MMODE) and must be compatible with it.

Commands and operands always have to be separated by at least one space. Depending on the command function, the operand may be altogether omitted or 1 operand or 2 operands, separated by spaces, must be entered. Refer to Serial Port Commands for a list of valid command mnemonics and to the individual command functions for the valid operand mnemonics associated with each command.

Numeric-strings take the form SD.DDDDESNN where SD.DDDD represents the signed mantissa. If the sign (S) is omitted, a positive value will be presumed. The decimal point may be anywhere in the mantissa string; if omitted, the decimal point will be presumed to be to the right of the last mantissa digit.

ESNN represents the signed exponent. If ESNN is altogether omitted, the exponent value is presumed to be zero. If the sign (S) is omitted, the exponent is presumed positive. The exponent value itself cannot exceed 2 decimal digits.

Numeric-strings may not contain any embedded spaces or any non-numeric characters other than '.', '+', '-' and 'E'. They have to be terminated by at least 1 space followed by a valid terminator.

Following is a list of valid terminator mnemonics:

MNEMONIC	FUNCTION
DB	dB units
DBM	dBm units
DBV	dBV units
HZ	Hz units
KHZ	kHz units
OHM	Ohms units
V	V units
MV	mV units
UV	μV units
%	% units
SP	Special function command (refer to 3.1.4)
RC	Recal function (refer to 3.7.2 and 3.7.3)
ST	Store function (refer to 3.7.1)

The only editing available is **<BACKSPACE>.**

3.1.4 SPECIAL FUNCTIONS

Refer to 3.12.3, Special Functions, for a list of instrument special functions and to the individual command functions for a description of valid special function operands. These functions are always entered as numeric strings and terminated by the **SPCL FUNCTION** key from the front panel and the SP terminator mnemonic from the serial port and GPIB interfaces. The numeric string that specifies a special function has to be of the form N.O where N refers to the special function number and determines which command function is being invoked and O refers to a valid operand associated with that function. If the 0th operand is selected, N.0 may be entered simply as N, with the decimal point and operand omitted. In most cases, the 0th operand of a special function is its default state. The SPCL FUNCTION LED is turned on whenever a non-default state of a special function is selected. This doesn't hold for the special display type functions (refer to 3.6.3) or certain other functions that don't support default states (refer to the individual Command Functions descriptions).

See Section 3.12.4 for a list of instrument default states.

3.1.5 NUMERIC ENTRY AND MODIFICATION MODE

Numeric entry and modification mode determines the context of numeric entry and the increment or decrement functions. It allows the user to specify a reference parameter to which all subsequent numeric entries, if terminated by a -UNITS- key or mnemonic, will be applied and to which all subsequent increment and decrement commands will be applied. If, for example, the current numeric entry and modification parameter is Source Amplitude and the value 5.5 is entered and terminated by the **kHz/dBm** key, Source Amplitude will be set to 5.5 dBm. If the same value is entered and terminated by the **Hz/dBV/dB** key, the new setting will be 5.5 dBV. If, however, under the same conditions, a numeric entry is terminated by the **%** key, an "Invalid Terminator" (error 5) will be generated because the assigned units are not compatible with the currently selected parameter, amplitude. As another example, if the currently selected numeric entry and modification parameter is Source Frequency and 5.5 is entered and terminated by the **kHz/dBm** key, Source frequency will be set to 5.5 kHz. In this case, both the **V** and **%** keys will cause an Invalid Terminator error to occur.

If either Source Amplitude, Source Frequency or SVF Frequency is the currently selected numeric entry parameter and the UP or DOWN command is invoked, the selected parameter will be incremented or decremented by the current Increment setting. If the currently selected numeric entry parameter is other than the ones mentioned above, using the UP and DOWN commands will result in "Unrecognized Command" (error 2).

SELECTING NUMERIC ENTRY AND MODIFICATION PARAMETERS

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Source Amplitude	**AMPLITUDE**	SRCAMP	AP
Source Amplitude Increment	**AMPLITUDE INCREMENT**	AMPINC	AN
Source Frequency	**FREQUENCY**	SRCFRQ	FR
Source Frequency Increment	**FREQUENCY INCREMENT**	FRQINC	FN
SVF Frequency	-	SVFFRQ	SF
SVF Frequency Increment	-	SVFINC	SN
IMD Offset Frequency	**IMD LOW FREQUENCY**	IMFREQ	IF
Relative Reference	**RELATIVE REFERENCE**	REF	RE

Default Setting: Source Amplitude

ANNUNCIATION

In all cases, except SVF Frequency and SVF Frequency increment, the front panel LED associated with the currently selected parameter is on; in the case of Source Amplitude and Frequency Increment parameters, the INCREMENT SET MODE LED will also be on. Caution, if SVF Frequency or SVF Frequency Increment are selected via the serial port or GPIB interface, the front panel annunciation of these conditions are identical to that of Source Frequency and Source Frequency Increment being selected.

Serial Port Header: NMMODE.

NOTES

For additional information concerning the individual parameters:

Parameter	References
Source Amplitude	3.4.1
Source Amplitude Increment	3.4.2
Source Frequency	3.4,3
Source Frequency Increment	3.4.4
SVF Frequency	3.2.7
SVF Frequency Increment	3.2.8
IMD Offset Frequency	3.4.5
Relative Reference	3.5.2

3.2 MEASUREMENT CONFIGURATION COMMANDS

3.2.1 INPUT SELECT

DESCRIPTION

Selects input signal for measurement. Options include external inputs A, B and internal sources A, B.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Input A	-INPUT- **A**	INSEL A	IA
Input B	-INPUT- **B**	INSEL B	IB
A output	-INPUT- **OSC A**	INSEL AOUT	IO
B output *	-INPUT- **OSC B***	INSEL BOUT *	BO*

-INPUT- **OSC A** and **OSC B** represent the shift of -INPUT- **A** and **B** key closures, respectively.

* NOTE: Output B requires Option 007.

DEFAULT SETTING

Input A

ANNUNCIATION

Current status always displayed by front panel **INPUT** LEDs.

Serial Port header: INSEL

NOTES

Selecting the internal source as input will not enable its output.

The A and B inputs may be either balanced or unbalanced depending on which input connector is used. The balanced input connector is a telephone style ring-tip-sleeve jack, while the unbalanced connector is a two terminal BNC jack. The normalizing contacts of the balanced jack are configured such that if a plug is inserted into it, the unbalanced jack is automatically disconnected.

Output Enable & Configuration should be adjusted appropriately before selecting internal source. Refer to 3.4.7 and 3.4.11 respectively.

3.2.2 INPUT TERMINATION

DESCRIPTION

Selects input termination for the A and B inputs. Options include Hi - Z (100 k ohms unbalanced, 200 k ohms balanced) (default option), 150 ohms and 600 ohms.

PROCEDURE

OPTIONS	FRONT PANEL	SERIAL	GPIB
100 k ohms	-input- **100 K**	INPZSEL HIZ	Z0
150 ohms	-input- **600/150**	INPZSEL IMP150	Z1
600 ohms	-input- **600/150**	INPZSEL IMP600	Z2

Front panel **100 k Ω** key always selects high impedance. **150 Ω/600 Ω** (i.e. SHIFT of **100 k Ω**) will select 600 Ω termination with the first push and 150 Ω on the second push, 600 Ω on the third push, etc.

DEFAULT SETTING

100 k ohms

ANNUNCIATION

Current status always displayed by front panel **INPUT TERMINATION** LEDs.

Serial Port header : INPZ

NOTES

The input termination is applied to either external A and B inputs depending on which, if either, is selected. The input termination is temporarily removed if a fatal error is detected and is restored by clearing the error.

It is the user's responsibility to avoid excessive dissipation in the input loading resistors but the software provides limited protection. If the current input termination setting is 150 ohms and input signal level, as calculated by the measurement process, exceeds approximately 15 V, input termination will be reset to its default option, 100 k ohms. Similarly, if the current setting is 600 ohms and input signal level exceeds approximately 30 V, input termination will be reset to its default option. Note that this protection is only available on the currently selected input while measuring, the selected input is not protected while the instrument is in the hold mode.

Selecting 150 or 600 ohms input impedance always forces dBm reference impedance to 150 or 600 ohms, respectively. Switching to 100 k ohms termination does not affect the dBm reference. This will remain until the dBm reference impedance is changed, either by selecting 600 ohms input termination or by explicitly setting the reference impedance. Reference impedance may always be reselected by the user, regardless of input termination status.

3.2.3 AUTOMATIC OPERATION

DESCRIPTION

Sets PGA, PGB, PGC, and detector speed operating modes to auto. If current measurement type is THD, selecting automatic operation will also set SVF tuning mode to auto and turn the servo on. Automatic operation is always the default state of the instrument.

PROCEDURE

FRONT PANEL	SERIAL	GPIB
9.0 **SPCL**	AUTO	AU

DEFAULT

Automatic operation enabled

ANNUNCIATION

If no other special functions are currently in effect, the **SPCL FUNCTION** LED should turn off.

NOTES

Special Function 9 supports one other valid option, Hold Settings (9.1), which freezes current settings. Refer to Section 3.2.4.

Selecting automatic operation simultaneously selects the auto option of several functions, all of which may be specified individually.

Refer to Sections :

3.2.5 PGA Level and Operating Mode
3.2.6 PGB Level and Operating Mode
3.2.12 PGC Level and Operating Mode
3.2.14 Detector Speed and Operating Mode
and 3.2.9 SVF Tuning Mode.

If Hold Settings operating mode is selected, the instrument is no longer considered to be in auto mode.

3.2.4 HOLD SETTINGS

DESCRIPTION

Sets PGA, PGB, PGC, and detector speed operating modes to hold, freezing current settings. If current measurement type is THD, selecting the hold settings option will also set SVF tuning mode to hold (but leave the servo on).

PROCEDURE

FRONT PANEL	SERIAL	GPIB
9.1 **SPCL**	HOLD	9.1SP

DEFAULT

Automatic operation is the default state of the instrument.

ANNUNCIATION

SPCL FUNCTION LED, if not already on, should turn on.

NOTES

Special Function 9 supports one other valid option, Automatic Operation (9.0). Refer to Section 3.2.3. Selecting Hold Settings simultaneously selects the hold current setting option of several functions, all of which may be handled individually.

Refer to Sections:

3.2.5 PGA Level and Operating Mode
3.2.6 PGB Level and Operating Mode
3.2.12 PGC Level and Operating Mode
3.2.14 Detector Speed and Operating Mode
and 3.2.9 SVF Tuning Mode

3.2.5 PGA LEVEL AND OPERATING MODE

DESCRIPTION

Selects PGA operating mode. If hold mode is selected, gain/attenuation may be frozen at the current setting or at a specified setting between -30 dB and +35 dB.

(PGA : Programmable Gain stage A - the input preamp and attenuator)

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Automatic	1.0 **SPCL**	PGA AUTO	1.0SP
Hold current	1.1 **SPCL**	PGA HOLD	1.1SP
Hold -30 dB	1.2 **SPCL**	PGA -30DB	1.2SP
Hold -25 dB	1.3 **SPCL**	PGA -25DB	1.3SP
Hold -20 dB	1.4 **SPCL**	PGA -20DB	1.4SP
Hold -15 dB	1.5 **SPCL**	PGA -15DB	1.5SP
Hold -10 dB	1.6 **SPCL**	PGA -10DB	1.6SP
Hold -5 dB	1.7 **SPCL**	PGA -5DB	1.7SP
Hold 0 dB	1.8 **SPCL**	PGA 0DB	1.8SP
Hold +5 dB	1.9 **SPCL**	PGA +5DB	1.9SP
Hold +10 dB	1.10 **SPCL**	PGA +10DB	1.10SP
Hold +15 dB	1.11 **SPCL**	PGA +15DB	1.11SP
Hold +20 dB	1.12 **SPCL**	PGA +20DB	1.12SP
Hold +25 dB	1.13 **SPCL**	PGA +25DB	1.13SP
Hold +30 dB	1.14 **SPCL**	PGA +30DB	1.14SP
Hold +35 dB	1.15 **SPCL**	PGA +35DB	1.15SP

DEFAULT SETTINGS

Automatic operation with initial setting at -30 dB.

ANNUNCIATION

If any of the hold options is selected, the **SPCL FUNCTION** LED should light. If the auto option is selected and if no other special functions are in effect, then the **SPCL FUNCTION** LED should be turned off.

Serial Port headers: PGASTS and PGAMD

NOTES

In automatic operating mode, PGA level is adjusted by the measurement process to optimize signal level. Holding level may lead to fatal errors, "Signal at PGAout overrange" (error 20) with any measurement type and "Signal at PGAout underrange" (error 21) during distortion or tracking bandpass type measurements.

Whenever a fatal error is generated, PGA level is temporarily set to -30 dB. This is not annunciated. Once the error condition is cleared, PGA level is restored to its original setting.

PGA operating mode and level may also be set by Automatic Operation and Hold Settings functions. Refer to Sections 3.2.3 and 3.2.4.

3.2.6 PGB LEVEL AND OPERATING MODE

DESCRIPTION

Selects PGB operating mode. If hold mode is selected, gain may be held at the current setting or at a specified setting between 0 dB and +80 dB.

(PGB: Programmable Gain stage B - the post filter/notch gain)

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Automatic	3.0 **SPCL**	PGB AUTO	3.0SP
Hold current	3.1 **SPCL**	PGB HOLD	3.1SP
Hold 0 dB	3.2 **SPCL**	PGB 0 DB	3.2SP
Hold +20 dB	3.3 **SPCL**	PGB +20 DB	3.3SP
Hold +40 dB	3.4 **SPCL**	PGB +40 DB	3.4SP
Hold +60 dB	3.5 **SPCL**	PGB +60 DB	3.5SP
Hold +80 dB	3.6 **SPCL**	PGB +80 DB	3.6SP

DEFAULT SETTING

Automatic operation with initial setting of 0 dB.

ANNUNCIATION

If any of the hold options is selected, the **SPCL FUNCTION** LED should light. If the auto option is selected and if no other special functions are in effect, then the **SPCL FUNCTION** should be turned off.

Serial Port headers: PGBSTS and PGBMD

NOTES

In automatic operating mode, PGB level is adjusted by the measurement process to optimize signal level. Holding level may lead to fatal error "Signal at PGBout overrange" (error 22) during measurement. PGB operating mode and level may also be set by Automatic Operation and Hold Settings functions. Refer to Sections 3.2.3 and 3.2.4.

3.2.7 SVF FREQUENCY

DESCRIPTION

Selects SVF frequency setting. (This function is not accessible from the front panel.) SVF frequency will automatically be set whenever source frequency setting is adjusted. Further, if SVF tuning is enabled, SVF frequency will track the input signal frequency as measured at PGA out. Valid range is from 10 Hz to 100 kHz.

(SVF: State Variable Filter - the notch or bandpass filter)

PROCEDURE

METHODS AVAILABLE	SERIAL	GPIB
Select SVF frequency numeric entry mode:	SVFFRQ	SF
Enter new setting: Numeric entry followed by units code, e.g.	1.5 KHZ	1.5KH
note: valid units are	KHZ, HZ	KH, KZ, HZ
Increment current setting by SVF frequency increment.	UP	UP
Decrement current setting by SVF frequency increment	DOWN	DN
Set to last measured frequency	DUP	-

Increment and decrement amounts are set by SVF Frequency Increment function.
Refer to Section 3.2.8.

DEFAULT SETTING

1 kHz

ANNUNCIATION

Current SVF frequency setting will only be written to the serial port when changed. It is not otherwise annunciated. SVF Frequency numeric entry mode is in effect if **SOURCE FREQUENCY** LED is on. Note that this is ambiguous with source frequency numeric entry mode but, because this mode cannot be entered from the front panel, no conflict is generally encountered.

Serial Port header: SVFFRQ

NOTES

SVF frequency tracks main oscillator frequency and will be set whenever oscillator frequency is adjusted. If, during THD and BP type measurement, SVF auto-tuning is enabled then SVF frequency tracks the selected input signal, i.e., if the difference between the currently set SVF frequency and the measured input frequency exceeds 2.5% then SVF frequency will be set to the measured frequency by the measurement process.

Selecting a new SVF frequency outside the range of 10 Hz to 100 kHz will cause an "Operand Out Of Range" (error 7) to be generated. This is true for any of the above described methods except during auto-tune mode operation, in which case the range is extended from 9.5 Hz to 105 kHz to allow for errors in setting the source frequency.

3.2.8 SVF FREQUENCY INCREMENT

DESCRIPTION

Selects SVF frequency increment setting. This function is not explicitly accessible from the Front Panel.

PROCEDURE

METHODS AVAILABLE	SERIAL	GPIB
Select SVF frequency increment numeric entry mode:	SVFINC	SN
Enter new setting: Numeric entry followed by units code, e.g.	.75 KHZ	.75KH
note: valid units are:	KHZ, HZ, %	KH, KZ, HZ, PE
Set to last measured frequency	DUP	

DEFAULT SETTING

1 Hz

ANNUNCIATION

Current SVF frequency increment will only be written to the serial port when changed. There is no other annunciation. Percentage increments will be displayed as the specified amount + 100%.

SVF Frequency increment numeric entry mode is in effect if **SOURCE FREQUENCY** and **INCREMENT SET MODE** LEDs are both on, which is ambiguous with source frequency increment but, because the mode cannot be entered from the front panel, no conflict is generally encountered.

Serial Port header: SVFINC

NOTES

SVF frequency increment is used to increment or decrement the current SVF frequency. Refer to Section 3.2.7. Modified SVF frequency is always checked and may, if the new value is out of the allowable range, cause an "Operand Out Of Range" (error 7) to be generated without attempting to set the new value.

The algorithm used to set relative increment adds 100% to the entered value, divides the result by 100 and preserves this value to be used as a multiplier of SVF frequency. Decrement is implemented by taking the reciprocal of this number as a multiplier. Thus relative increments, when displayed in %, will always be displayed + 100%.

Once a new SVF frequency increment value has been entered, the instrument will automatically revert to SVF frequency numeric entry mode.

3.2.9 SVF TUNING/TRACKING MODE

DESCRIPTION

The SVF tuning and tracking functions enable or disable SVF auto- tuning and the fine tune servo. The tuning function (special function 6), which may only be used during THD type measurements, allows the user to enable or disable auto-tuning but prohibits the disabling of the servo. The tracking function (special function 28), which may only be used during BP (band pass) type measurements, allows the user to enable or disable both auto-tuning and the servo.

Auto-tuning is the coarse tuning of the filter in response to the frequency of the INPUT signal. Servo is the fine tuning (nulling) of the filter to the frequency of the INPUT signal.

PROCEDURE

CASE OF THD TYPE MEASUREMENT ONLY			
CHOICES	**FRONT PANEL**	**SERIAL**	**GPIB**
Enable auto-tuning and servo	**6.0 SPCL**	**TUNE AUTO**	**6.0SP**
Disable auto-tuning & enable Servo (notch lock mode)	**6.1 SPCL**	**TUNE HOLD**	**6.1SP**

CASE OF BP TYPE MEASUREMENT ONLY			
CHOICES	**FRONT PANEL**	**SERIAL**	**GPIB**
Disable auto-tuning (follow oscillator)	**28.0 SPCL**	**TRACK OFF**	**28.0SP**
Enable auto-tuning (follow input)	**28.2 SPCL**	**TRACK TON**	**28.2SP**

DEFAULT

SVF auto-tuning disabled in all measurement types except THD where it is enabled.

ANNUNCIATION

If no other special functions are in effect during THD measurement and 'auto' option is selected, the **SPCL FUNCTION** LED should turn off. If the 'hold' option is selected, the **SPCL FUNCTION** should light.

If no other special functions are in effect during BP measurement and tracking is turned off, the **SPCL FUNCTION** LED should turn off. If any other option is selected, the **SPCL FUNCTION** should light.

Serial Port headers: SRVST and TUNEMD

NOTES

When THD type measurement is selected, SVF auto-tuning and servo are automatically enabled. Auto-tuning may subsequently be disabled via special function 6. Attempting to use special function 28 in this case will cause an "Unrecognized Command" (error 2) to be generated.

When any non-THD type measurement is selected, SVF auto-tuning and servo are automatically disabled. In BP type measurement, auto-tuning may subsequently be enabled via special function 28. In non-BP type measurement, attempting to use other than the 'tracking off' option of special function 28 will cause an "Unrecognized Command" (error 2) to be generated. In both cases, attempting to use special function 6 will cause an "Unrecognized Command" (error 2) to be generated.

During THD type measurement, the Automatic Operation and Hold Settings functions will, respectively, enable and disable auto-tuning.

3.2.10 WEIGHTING FILTERS

DESCRIPTION

Selects 1 of 7 weighting filters or disables them all.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Disable all	See Notes below	FILSEL OFF	L0
30kHz LP	-filters- **30k**	FILSEL 30K	L1
80kHz LP	-filters- **80k**	FILSEL 80K	L2
Special	-filters- **SPCL**	FILSEL SPCL	L3
Auxiliary 1 *	-filters- **AUX1**	FILSEL SP0	L4
Auxiliary 2 *	-filters- **AUX2**	FILSEL SP1	L5
Auxiliary 3 *	-filters- **AUX3**	FILSEL SP2	L6
Auxiliary 4 *	-filters- **AUX4**	FILSEL SP3	L7

* NOTE: Auxiliary filters 1 through 4 require Option 005 or 006.

DEFAULT

All weighting filters disabled.

ANNUNCIATION

Current status always displayed by Front Panel **FILTERS** LEDs.

Serial Port header: WFSEL

NOTES

The logic of the filter select for the front panel is such that selecting any filter will disable the currently selected filter. Reselecting the currently selected filter will therefore turn it off.

3.2.11 HIGH PASS FILTER

DESCRIPTION

Enables or disables the 400 Hz HP filter.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Disable HP	-filters- **HP**	HPFIL OFF	H0
Enable HP	-filters- **HP**	HPFIL ON	H1

DEFAULT

HP filter disabled

ANNUNCIATION

Current status always displayed by Front Panel **FILTERS** LEDs.

Serial Port header: HPSEL

NOTES

The HP filter is automatically disabled when IMD type measurement is selected. Any subsequent attempts to turn it on will result in an "Unrecognized Command" (error 2).

The front panel **HP** filter key alternates on and off so that if the HP filter is enabled, the next pressing of the **HP** key will turn it off, and if disabled, the next pressing will enable it.

3.2.12 PGC LEVEL AND OPERATING MODE

DESCRIPTION

Selects PGC operating mode. If hold mode is selected, the gain may be frozen at the current setting or at a specified setting between 0 dB and +20 dB.

(PGC: Programmable Gain stage C - post weighting filter gain)

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Automatic	27.0 **SPCL**	PGC AUTO	27.0SP
Hold current setting	27.1 **SPCL**	PGC HOLD	27.1SP
Hold 0 dB	27.2 **SPCL**	PGC 0DB	27.2SP
Hold +10 dB	27.3 **SPCL**	PGC +10DB	27.3SP
Hold +20 dB	27.4 **SPCL**	PGC +20DB	27.4SP

DEFAULT SETTING

Automatic operation with initial gain of 0 dB

ANNUNCIATION

If any of the hold options is selected, the **SPCL FUNCTION** LED should light. If the auto option is selected and if no other special functions are in effect, then the **SPCL FUNCTION** should be turned off.

NOTES

In automatic operating mode, PGC level is automatically adjusted by the measurement process to optimize signal level. Holding the setting may lead to fatal error "Signal at PGC out overrange" (error 24) during measurement.

PGC operating mode may also be set by Automatic Operation and Hold Settings functions. Refer to sections 3.2.3 and 3.2.4.

3.2.13 DETECTOR SELECT

DESCRIPTION

Selects RMS, average of absolute value or quasi-peak type detection characteristic.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
True rms	**DETECTOR**	DETSEL RMS	D0
Average	**DETECTOR**	DETSEL AVE	D1
Quasi-Peak	**DETECTOR**	DETSEL QPK	D2

DEFAULT SETTING

RMS

ANNUNCIATION

The currently selected detector is always displayed to the right of the Front Panel left display.

Serial Port header: DETSEL

NOTES

Successive depressions of the front panel **DETECTOR** key will select detectors in the following order: RMS-AVE-QPK-RMS ... etc.

3.2.14 DETECTOR SPEED AND OPERATING MODE

DESCRIPTION

Selects RMS detector speed operating mode. If hold mode is selected, speed may be frozen at its current setting or at a specified setting between very slow and very fast.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Automatic	29.0 **SPCL**	DETSPD AUTO	29.0SP
Hold current	29.1 **SPCL**	DETSPD HOLD	29.1SP
Hold very slow	29.2 **SPCL**	DETSPD VSLOW	29.2SP
Hold slow	29.3 **SPCL**	DETSPD SLOW	29.3SP
Hold fast	29.4 **SPCL**	DETSPD FAST	29.4SP
Hold very fast	29.5 **SPCL**	DETSPD VFAST	29.5SP

DEFAULT SETTING

Automatic operation with initial speed set to very slow.

ANNUNCIATION

If any of the hold options is selected, the **SPCL FUNCTION** LED should light. If the auto option is selected and if no other special functions are in effect, the **SPCL FUNCTION** should be turned off.

Serial Port header: DETSPD

NOTES

The implementation of the 5500 hardware and software only requires that the RMS detector's averaging time constant be changed to accommodate varying input frequencies. Both the average value and quasi-peak response are optimized by the actions of the synchronous integration measurement cycle which permits minimal response times without perceptible ripple even at 10 Hz.

In automatic operating mode, detector speed is adjusted by the measurement process according to the calculated input signal frequency. Holding detector speed may result in loss of accuracy but will not generate any errors during measurement. Refer to Measurement Flow Description 3.10.1 through 3.10.7.

A situation may arise during automatic operation that will lead to readings of slightly less accuracy than expected because of the way that frequency is computed. The input signal frequency is derived from input signal zero crossings which, theoretically, do not necessarily reflect the signal energy content. Thus if a composite input signal containing significant amounts of low frequency energy also contains enough high frequency energy to activate the zero crossing detector, the software may choose an inappropriate detector speed for the low frequency component. This situation may easily be encountered when making noise measurements but normally noise is not measured to the full accuracy of the instrument and the resulting readings are entirely adequate. A more noticeable example of this error would be the rms level measurement of a two frequency composite signal - the CCIF twin-tone signal, for example. Typically such a signal would be two relatively high frequency signals with a low difference frequency. The frequency measuring detector of the 5500 would usually interpret the "frequency" of this twin-tone signal as approximately the mean value of the two individual signals and thus set the rms detector time constant to this high frequency value. It would then not be responsive to the low frequency difference component and the resulting rms value would have an error of up to 1 dB. This situation may, however, be avoided in these special situations by holding the detector speed at one which is appropriate for the measurement being performed. As mentioned above, this will only apply to the RMS type detector.

Detector speed and operating mode may also be set by Automatic Operation and Hold Settings functions. Refer to Sections 3.2.3 and 3.2.4.

3.2.15 AUTOMATIC CALIBRATION

DESCRIPTION

This function will generate a number of calibration constants that are used during measurement and instrument setup. When selected, it executes a series of measurements and uses the results to re-calculate the V-F scale factor and offsets, the detector normalization factors, and source and SVF frequency scale factors. For a description of the usage of these data, refer to the Measurement Flow Descriptions of Section 3.10.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Re-calibrate	24 **SPCL**	24 SP	24SP

NOTES

The auto-cal procedure requires that all external loads and inputs be disconnected from the fully warmed up instrument. The process requires approximately 30 seconds and stores its results in non- volatile RAM along with a CRC to guarantee the validity of the data. No other command will be responded to while the auto-cal process is executing although any input will be buffered under interrupt to the limit of the various input buffers. The instrument state is saved in memory location 1 prior to the auto-cal call and will thus overwrite any information contained there. Upon exiting the auto-cal procedure, the previous instrument state will be restored. Note that all parameters are derived from two primary system constants, the DC VREF generator on the detector module and the master crystal clock oscillator on the CPU module. It is especially important not to disturb the VREF calibration control on the detector module without having a precision DC voltmeter available to calibrate it to its specified accuracy (see detector module calibration procedure). The auto-cal procedure may generate Error 60 if it determines that it cannot measure certain parameters due to hardware failure. In this case please refer servicing to qualified service personnel.

3.2.16 DC VOLTS MEASUREMENT MODE
(requires option 008)

DESCRIPTION

Enables DC Volts measurement mode. DC Volts measurement is disabled by selecting any other measurement type.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Enable	**DC**	DC	DC

DC represents the shift of the **WIDE BAND** key on the instrument front panel.

DEFAULT SETTING

DC Volts measurement disabled.

ANNUNCIATION

The current status is always displayed on the Front Panel by the -DC- LED below the **WIDE BAND** key.

Serial Port header: DCMODE. If DC Volts measurement is enabled the DCMODE segment displays DC.

NOTES

The DC signal measurement chain is independent of the AC measurement chain up to the detector module. The AC chain continues to provide the signal that is measured by the frequency counter, and thus will set the measurement synchronization. This allows the instrument measuring circuits to reject the AC component of a composite AC-DC signal. While DC volts measurement is enabled, frequency data produced by the instrument will depend on the current state of Measurement Sync. Only in the case of DC volts type measurement: if frequency readings are not available, Error 47 "Can't get frequency reading" will never be generated. Instead, the instrument will display a frequency reading of 0.0 Hz. This can be used to extend the measurement resolution by selecting "Internal" as the frequency counter source and setting the source amplitude to 0 Volts. In this case the measurement will be made over the longest integration time and yield the highest resolution results. See "DC Range Select' for possible errors.

DC scale is selected by Special Function 2. Refer to 3.2.17.

For a more detailed description of DC Volts measurement refer to the Measurement Flow Descriptions of Section 3.10.

Note that the display formatting functions are not available during DC and Phase type measurements.

3.2.17 DC RANGE SELECT
requires option 008)

DESCRIPTION

Selects full scale range for DC Volts measurement. Choices include 100 V, 1 V and 1 V ranges.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
100 Volt full scale	2.0 **SPCL**	2.0 SP	2.0SP
10 Volt full scale	2.1 **SPCL**	2.1 SP	2.1SP
1 Volt full scale	2.2 **SPCL**	2.2 SP	2.2SP

DEFAULT SETTING

100 Volt range.

ANNUNCIATION

Serial Port header: DCSCL

NOTES

The operator is responsible for the range selection for DC Volts measurements. Error 30 will be produced if either input is more negative than the allowable input range and Error 32 will be produced if either input is more positive than the allowable input range. These errors will only be produced if the input significantly exceeds the specified input over-range capabilities.

3.2.18 DC FEEDBACK SELECT
(requires Option 008)

DESCRIPTION

This function affects the feedback around the input amplifier in the DC measurement chain. This provides the user with the ability to define the gain or other characteristic of this stage.

PROCEDURE

Enter the special function code followed by 0 or 1 to select the default (full feedback) or other (user defined feedback).

CHOICES	FRONT PANEL	SERIAL	GPIB
Full feedback	85.0 **SPCL**	85.0 SP	85.0SP
Special Feedback	85.1 **SPCL**	85.1 SP	85.1SP

DEFAULT SETTINGS

Full feedback.

ANNUNCIATION

None.

NOTES

This provides the user with a means of scaling the DC input channel to a value other than the default of unity gain. The actual feedback term is chosen by the user by means of component choice on the DC signals module. It is assumed that this function will only be exercised by users familiar with the design of feedback circuits around operational amplifiers. The actual measuring circuits have no way of determining what gain is actually set and will assume a unity gain value for purposes of displaying the measurement results.

An example of an application of this feature would be to modify the scaling so the digital readout represented a particular value based on an external transducer - for example, temperature in °F using an external temperature to DC converter.

3.2.19 PHASE MEASUREMENT MODE
(requires option 009)

DESCRIPTION

Enables Phase measurement. Phase measurement is disabled by selecting any other measurement type.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Enable	**PZ**	PZ	PZ

PZ represents the shift of the **NARROW BAND** key on the instrument front panel.

DEFAULT SETTING

Phase measurement disabled.

ANNUNCIATION

The current status is always displayed on the Front Panel by the -PZ- LED below the **NARROW BAND** key.

Serial Port header: DCMODE. If Phase measurement is enabled the DCMODE segment displays PZ.

NOTES

While phase measurement is enabled, frequency data produced by the instrument will depend on the current state of Measurement Sync.

Phase scale is selected by Special Function 8. Refer to 3.2.19.

For a more detailed description of Phase measurement refer to the Measurement Flow Descriptions of Section 3.10.

Note that the display formatting functions are not available during DC and Phase type measurements.

3.2.20 PHASE SCALE SELECT
(requires option 009)

DESCRIPTION

Selects reference scale for Phase measurement. Choices include 0 to 360 and 180.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
± 180°	8.0 **SPCL**	8.0 SP	8.0SP
0° to 360°	8.1 **SPCL**	8.1 SP	8.1SP

DEFAULT SETTING

± 180°

ANNUNCIATION

Serial Port header: PZSCL

NOTES

The operator is responsible for selecting which scale will be used for phase measurements. This function affects not only the display format but also the phase measurement hardware.

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3.3 MEASUREMENT CONTROL COMMANDS

3.3.1 MEASUREMENT TYPE

DESCRIPTION

Selects type of measurement to be performed.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Wide band level	**WIDE BAND**	AMPMSM WB	M1
Very wide band pass level	**NARROW BAND**	AMPMSM BPVW	M4
Wide band pass level	**NARROW BAND**	AMPMSM BPW	M5
Medium band pass level	**NARROW BAND**	AMPMSM BPM	M6
Narrow band pass level	**NARROW BAND**	AMPMSM BPN	M7
High pass level	**NARROW BAND**	AMPMSM HP	M8
Low pass level	**NARROW BAND**	AMPMSM LP	M9
THD (ratio)	**THD**	AMPMSM THD	S3
THD level	**36.0 SPCL**	AMPMSM THDL	M3
* IMD CCIF (option 002)	**IMD CCIF**	AMPMSM CCIF	S4
* IMD SMPTE (option 002)	**IMD SMPTE**	AMPMSM SMPTE	S5
* DC Volts (option 008)	**DC**	DC	DC
* Phase (option 009)	**PHASE**	PZ	PZ

- the **NARROW BAND** key is a "rotary" key. Successive depressions of the key will select measurement type in the following order: BP very wide, BP wide, BP medium, BP narrow, HP - LP - BP very wide.

- whenever narrow band is reselected, the last narrow band type used will be automatically restored.

* These modes require certain optional features to be resident in the instrument.

DEFAULT SETTING

Wide band level

ANNUNCIATION

Current status is always displayed by Front Panel -FUNCTION- LEDs.

Serial Port header: AMPMSM

NOTES

If THD type measurement is selected, SVF auto-tuning is automatically enabled and the servo turned on; in all other cases, SVF auto-tuning is disabled and the servo turned off. The tuning function (special function 6) may only be used during THD type measurement while the tracking function may only be used during BP type measurement. Refer to Section 3.2.9.

If IMD SMPTE* type is selected, IMD ratio is automatically set to 1:4; in all other cases, IMD ratio is set to 1:1. Refer to Section 3.4.6.

If IMD SMPTE* or CCIF* type is selected, the high pass filter will be automatically turned off and any attempts to turn it on during IMD measurement will result in an "Unrecognized Command" (error 2). Refer to 3.2.11.

If IMD SMPTE* or CCIF* type is selected and current source frequency is set to less than 2 kHz, the source frequency will automatically be reset to 7 kHz. Refer to 3.4.3.

If the current measurement type is distortion, THD or IMD*, and the relative mode is enabled, then selecting non-distortion type measurement will automatically disable relative mode. Similarly if current type is level type and relative mode is enabled, then selecting distortion type will disable relative mode. Refer to 3.5.1.

If the current measurement type is distortion and level type measurement is selected, then the last specified absolute amplitude display units will be restored unless display mode has been modified, in which case, the appropriate log or linear version of the last specified absolute units will be selected. If a distortion type measurement is selected, the amplitude display unit will always default to % if in linear, and to dB, if in log display mode. Refer to 3.5.3 and 3.5.4.

The different types of measurement are described in more detail by Sections 3.10.1 through 3.10.7.

*IMD functions require Option 002.

3.3.2 MEASUREMENT MODE

DESCRIPTION

Select measurement control mode. In normal operating mode, the free- run mode, the instrument is continuously executing measurements and hardware settling delays are always on to provide time for the hardware to settle after making any change to the gains or SVF frequency. It may also be configured to only execute a measurement when triggered and to ignore settling delays. The measurement mode may only be modified via the GPIB.

PROCEDURE

CHOICES	GPIB
Free-run mode	T0
Hold mode	T1
Trigger then Hold mode (with settling disabled)	T2
Trigger then Hold mode (with settling enabled)	T3

DEFAULT SETTING

Free-run mode

ANNUNCIATION

Measurement mode is not annunciated on the Front Panel. Serial Port header: MSMODE

NOTES

In the free-run mode, measurement is continuous; the end of one measurement starts the next. In either of the triggered modes, a single measurement attempt is performed initially while subsequent measurement attempts are performed when triggered. In the hold mode, the instrument prepares itself for measurement and awaits commands; measurements must always be triggered explicitly.

Note that a measurement proceeds until complete or aborted by an error or an exception. The result of a triggered measurement may therefore return an error or exception instead of a measured value. In an automation environment it is necessary to check the values returned for error or exception codes and proceed accordingly. See Sections 3.11.1 and 3.11.2.

A single measurement may be triggered in either of two ways:

FRONT PANEL	**SERIAL**	**GPIB**
1. **CLR**	CLEAR	CL
2. -	-	GET (bus command)

The front panel will only trigger a measurement if not in "local lockout".

Refer to Sections 3.8.3 and 3.8.1.

Hardware settling delays are disabled only in Trigger with settling disabled mode.
Refer to measurement descriptions, Section 3.10.

3.3.3 MEASUREMENT SYNC

DESCRIPTION

Determines source of measurement synchronization for the synchronous integration interval and/or displayed frequency measurement.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
External	37.0 **SPCL**	FRQMSM IN	FI
Internal	37.1 **SPCL**	FRQMSM OSC	FO

DEFAULT SETTING

External

ANNUNCIATION

Current measurement sync status is always displayed by Front Panel **OSC** LED which is turned off if external input is selected and on if internal sync is selected.

Serial Port header: FRQMSM.

NOTES

This function may have a serious effect on a number of instrument parameters and should be used with discretion by persons having a good understanding of the measurement flow descriptions.

Primarily, this function selects the source that the measurement will use to set the synchronous integration period, the reciprocal of which is the frequency displayed on the left display in all cases except IMD*. In all measurement types but IMD*, the external sync select will cause the frequency of the input signal, as measured by the zero crossing detector, to be the sync input for synchronous integration and the internal sync select will use the main internal oscillator as the sync source. In this latter case, the synchronous integration will yield the frequency of the internal source for display and will give the shortest possible measurement time when the instrument is providing the stimulus for the device under test in real time.

In the case of IMD*, the external option will cause the measurement sync to be taken from the low frequency component of the input signal and the internal option will use the internal IMD* low frequency oscillator as the sync source. When the sync source is specified as external (default option), an additional measurement is performed to measure the recovered high frequency component of the input signal which will be displayed on the left display. When the internal sync option is chosen, the instrument will not take another measurement but will display the frequency of the internal LF oscillator. This latter case will give the shortest possible measurement time when the instrument is providing the stimulus for the device under test in real time.

*IMD function requires Option 002.

TABLE 3.3.3

MEASUREMENT SYNC SOURCE

INSTRUMENT FUNCTION	SYNC MODE (SPCL FNTC)	SYNC SOURCE (integration)	FREQUENCY INDICATION (right hand display)
LEVEL, THD	INPUT (37.0)	INPUT SIGNAL	INPUT SIGNAL FREQUENCY
LEVEL, THD	OSC (37.1)	GENERATOR SIGNAL	GENERATOR SIGNAL FREQUENCY
IMD, SMPTE* (option 002)	INPUT (37.0)	LF component of INPUT signal	HF component of INPUT signal
IMD, SMPTE* (option 002)	OSC (37.1)	LF component of OUTPUT signal	LF component of OUTPUT signal
IMD, CCIF* (option 002)	INPUT (37.0)	Offset frequency of INPUT signal	Mean freq. of INPUT of INPUT signal ± 10%
IMD, CCIF* (option 002)	OSC (37.1)	Offset frequency of OUTPUT signal	Offset frequency of OUTPUT signal
DC, PHASE* (options 008, 009)	INPUT (37.0)	AC phase of INPUT signal	Freq. of AC component or 0 Hz
DC, PHASE* (options 008, 009)	OSC (37.1)	Freq. of internal main oscillator	Internal main oscillator freq.

* requires the indicated options

3.4 SIGNAL GENERATION COMMANDS

3.4.1 SOURCE AMPLITUDE

DESCRIPTION

Notes on setting or modifying source amplitude.

The actual output level setting depends on three variables: programmed source amplitude (as described below), source impedance, and output load impedance reference (either level or power depending on the choice of programmed source amplitude units).

In addition, the MAXIMUM allowable output level setting depends on three variables: generator output configured as balanced or unbalanced, source impedance, and output load impedance reference (either level or power depending on the choice of programmed source amplitude units.)

Variables used in the following equations:

A_S (V) : Maximum Source Amplitude in Volts
A_S (dBV): Maximum Source Amplitude in dBV
A_S (dBm): Maximum Source Amplitude in dBm
Z_S : Source Impedance
$Z_L^{(L)}$: Load Impedance (Level - V or dBV)
$Z_L^{(P)}$: Load Impedance (Power - dBm)
V_{MAX} = Maximum Output Voltage (33.11 V if Z_S = 150 or 600 Ω, 16.56 V if Z_S = 50 Ω)

If the amplitude setting is entered in Volts or dBV units and the output load impedance (Volts or dBV) is currently specified as infinity, the unloaded or open circuit case, maximum level is 33.11 Volts in the balanced case (source impedance configured at 600 or 150 ohms) and 16.56 Volts in the unbalanced case source impedance of 50 ohms).

For amplitude settings in Volt units where the LEVEL output load impedance reference $Z_L^{(L)}$ is currently specified at 1 to 9998 ohms, the maximum level is:

$$A_s\,(V) = V_{MAX} \left[\frac{Z_L^{(L)}}{Z^{(L)} + Z_s} \right]$$

For amplitude settings in dBV units where the LEVEL output load impedance reference $Z_L^{(L)}$ is currently specified at 1 to 9998 ohms, the maximum level is:

$$A_s\,(\mathrm{dBV}) = 20 \log \left[V_{MAX} \left[\frac{Z_L^{(L)}}{Z^{(L)} + Z_s} \right] \right]$$

For amplitude settings in dBm units where the POWER output load impedance reference $Z_L^{(P)}$ is currently specified at 1 to 9999 ohms, the maximum level is:

$$A_s\,(\mathrm{dBm}) = 10 \log \left[\frac{\dfrac{\left[V_{MAX} \left[\dfrac{Z_L^{(P)}}{Z_L^{(P)} + Z_S} \right] \right]^2}{Z_L^{(P)}}}{0.001} \right]$$

METHODS AVAILABLE

First select Source amplitude numeric entry mode, then use one of the following methods to set the new value:

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "AMPL" MODE	**AMPLITUDE**	SRCAMP	AP
Enter a new value: e.g. 1.5 Volts valid units:	 **1.5 V** **V, dBm, dBV**	 1.5 V V,MV,UV, DBM,DBV	 1.5VL VL,MV,UV, DM,DV
Set source amplitude to last measured value	*	DUP	-
Increment current source amplitude setting	**UP**	UP	UP

Increment and decrement values are determined by the current Source Amplitude Increment setting. Refer to Section 3.4.2.

DEFAULT SETTING

0 V

ANNUNCIATION

Source amplitude numeric entry mode is in effect if **AMPLITUDE** LED is on.

The current source amplitude setting will be displayed on the front panel left display if the **AMPLITUDE** key is held or if special function 10 is selected. Refer to 3.6.2 and 3.6.3.

Serial Port header: SRCAMP

NOTES

Selecting a source amplitude setting outside the range of 0 V to the maximum level, as described above, will cause an "Operand Out Of Range" (error 7) to be generated. This is true for any of the above described methods of modifying source amplitude.

Modifying output structure, (refer to 3.4.9) or output load impedance reference (refer to 3.4.10) will cause source amplitude to be reset and may cause an "Operand Out Of Range" (error 7) to be generated. If this occurs, the actual level setting will not correspond to the programmed source amplitude. Source and output load impedance configuration and source amplitude should be reselected.

Selecting 0 V automatically turns the main oscillator off; entering any non-zero value turns it on again.

The sequence used to modify the gain and attenuation of the output amplifier and attenuator is designed to avoid presenting transient voltages higher than either the old or the new setting to the output connector.

Source amplitude will always be displayed in the original entry units regardless of the currently selected display units.

It should be carefully noted that source amplitude will always be determined in terms of the current output load impedance reference whereas measurement data displayed in power units will be calculated in terms of the current input impedance reference and that the two sets of references are uncorrelated.

3.4.2 SOURCE AMPLITUDE INCREMENT

DESCRIPTION

Selects new source amplitude increment setting which is used for the increment and decrement functions.

METHODS AVAILABLE

First select Source Amplitude Increment numeric entry mode, then use one of the following methods to set the new value:

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "AMPL INCR" MODE	**AMPL INCR**	AMPINC	AN
Enter new value: e.g. 1.5 Volts	1.5 **V**	1.5 V	1.5VL
Valid units:	**V, %, dB**	V,MV,UV,%, DB	VL,MV,UV, PE, DB
Set to last measured amplitude	*	DUP	-

DEFAULT SETTING

1.0 V

ANNUNCIATION

Source amplitude increment numeric entry mode is in effect if **AMPLITUDE** and **INCREMENT SET MODE** LEDs are on.

The current source amplitude increment will be displayed on the front panel left display if the **AMPL INCR** key is held. Refer to 3.6.2.

Serial Port header: AMPINC.

NOTES

Source amplitude increment is used to increment or decrement the current source amplitude. Refer to Section 3.4.1. Modified source amplitude is checked and may, if the new value is out of range, cause an "Operand Out Of Range" (error 7) to be generated.

Relative increment values, if displayed in % units, will always be displayed + 100 %.

The algorithm used to set relative increment adds 100% to the entered value if specified in percent, divides the result by 100 and preserves this value to be used as a multiplier of source amplitude. Decrement is implemented by taking the reciprocal of this number as a multiplier. Thus relative increments, when displayed in %, will always be displayed + 100%.

Once a new source amplitude increment value has been entered, the instrument will automatically revert to source amplitude numeric entry mode.

3.4.3 SOURCE FREQUENCY

DESCRIPTION

Sets or modifies the programmed source frequency. Valid range is from 10 Hz to 100 kHz.

METHODS AVAILABLE

First select Source Frequency numeric entry mode then use one of the following methods to set the new value:

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "FREQ" MODE	**FREQUENCY**	SRCFRQ	FR
Enter new values: e.g. 1.5 kHz Valid units:	 1.5 **kHz** **Hz, kHz**	 1.5 KHZ KHZ, HZ	 1.5KH KH, KZ, HZ
Increment setting by source frequency measurement	**UP**	UP	UP
Decrement setting by source frequency measurement	**DOWN**	DOWN	DN
Set to last measured frequency	*	DUP	-

Increment and decrement amounts are set by Source Frequency Increment function. Refer to Section 3.4.4.

DEFAULT SETTING

1 kHz

ANNUNCIATION

Source frequency numeric entry mode is in effect if **FREQUENCY** LED is on. Note that this is ambiguous with narrow band filter (SVF) frequency numeric entry mode. Refer to Section 3.2.7.

The current source frequency setting will be displayed on the front panel right display if the **FREQUENCY** key is held or if special function 10 is selected. Refer to 3.6.2 and 3.6.3.

Serial Port header: SRCFRQ.

NOTES

SVF frequency tracks source frequency and will be automatically adjusted whenever oscillator frequency is modified. Refer to 3.2.7.

If IMD* type measurement is selected and the current setting is under 2 kHz, source frequency will be automatically reset to 7 kHz. Refer to 3.3.1.

Selecting new frequency outside the range of 10 Hz to 100 kHz will cause an "Operand Out Of Range" (error 7) to be generated. This is true for any of the above described methods.

* IMD function requires Option 002.

HIGH RESOLUTION FINE TUNE
(Requires option 201)

Special Function 13 allows fine tuning at the oscillator to a resolution at better than 0.005% over approximately a one percent range. An operand value at 0 to 255 sets the trim value.

To modify the current oscillator frequency, enter 13.nnn SPCL FNCT, where nnn is a value from 0 to 255.

This is an uncalibrated adjustment and is only used to effect minor changes manually.

3.4.4 SOURCE FREQUENCY INCREMENT

DESCRIPTION

Sets the source frequency increment value which is used for the increment and decrement functions.

METHODS AVAILABLE

First, select Source Frequency Increment numeric entry mode then use one of the following methods to set the new value.

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "FREQ INCR" MODE	**FREQ INCR**	FRQINC	FN
Enter new value:			
e.g. 0.75 kHz	**.75 kHz**	.75 KHZ	.75KH
Valid units:	**kHz, Hz, %**	KHZ,HZ,%	KH,HZ,PE
Set to last measured frequency	*	DUP	-

DEFAULT SETTING

1 Hz

ANNUNCIATION

Source frequency increment numeric entry mode is in effect if **FREQUENCY** and **INCREMENT SET MODE** LEDs are both on. Note that this is ambiguous with narrow band filter (SVF) frequency increment mode. See Section 3.2.8.

The current frequency increment setting will be displayed on the front panel right display if the **FREQ INCR** key is held. Refer to 3.6.2.

Serial Port header: FRQINC

NOTES

Source frequency increment is used to increment or decrement the current source frequency. Refer to Section 3.4.3. Modified frequency is always checked and may, if the new value is out of range, cause an "Operand Out Of Range" (error 7) to be generated.

Relative increments, when displayed in %, will always be displayed + 100 %.

The algorithm used to set relative increment adds 100% to the entered value if entered in percent, divides the result by 100 and preserves this value to be used as a multiplier of source frequency. Decrement is implemented by taking the reciprocal of this number as a multiplier. Thus relative increments, when displayed in %, will always be displayed + 100%.

Once a new source frequency increment value has been entered, the instrument will automatically revert to source frequency numeric entry mode.

3.4.5 IMD OFFSET FREQUENCY
(requires option 002)

DESCRIPTION

Selects new IMD offset frequency setting. Allowable settings are 40 Hz, 50 Hz, 60 Hz, 80 Hz, 100 Hz, 125 Hz, 250 Hz and 500 Hz. All entered values will be rounded to the nearest allowable setting (i.e, if 185 Hz is selected, IMD frequency will be set to 250 Hz). The offset frequency referred to in this manual is the low frequency component of the composite test signal in the SMPTE/DIN IMD method and the offset from mean frequency in the CCIF "twin-tone" IMD method (i.e. one half the difference frequency).

METHODS AVAILABLE

First, select IMD Low Frequency numeric entry mode then use one of the following methods to set the new value:

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "IMD LF" MODE	**IMD LOW FREQ**	IMFREQ	IF
Enter new value:			
e.g. 80 Hz	**80 Hz**	80 HZ	80 HZ
Valid units:	**kHz, Hz**	KHZ,HZ	KH, KZ, HZ
Set to last measured frequency	*	DUP	-

DEFAULT SETTING

60 Hz.

ANNUNCIATION

IMD frequency numeric entry mode is in effect if **IMD LOW FREQ** LED is on.

The current IMD frequency setting will be displayed on the front panel right display if the **IMD LOW FREQ** key is held. Refer to 3.6.2.

Serial Port header: IMFREQ

NOTES

IF REQUESTED FREQUENCY IS	ACTUAL SETTING IS
<45 Hz	40 Hz
≥45 Hz and < 55 Hz	50 Hz
≥55 Hz and <70 Hz	60 Hz
≥70 Hz and < 90 Hz	80 Hz
≥90 Hz and <112.5 Hz	100 Hz
≥112.5 Hz and <187.5 Hz	125 Hz
≥187.5 Hz and < 375 Hz	250 Hz
≥375 Hz	500 Hz

Since all entries are rounded to the nearest valid setting, entering out-of-range values should not generate an error.

The offset frequency is actually the operating frequency of the internal IMD low frequency oscillator. The term "offset frequency" is used instead of "difference frequency" or "low frequency" to avoid ambiguity especially in the case of CCIF IMD, where the difference frequency is twice the offset frequency and "low frequency" may be misconstrued as the lower of the two sidebands.

If the offset frequency is set to 100 Hz and the "main" (i.e., high or mean) frequency is 10 kHz then in SMPTE/DIN the two frequencies will be 100 Hz and 10 kHz. In CCIF the two frequencies provided by the generator will be 9.9 kHz and 10.1 kHz (the difference frequency being twice the offset frequency i.e., 200 Hz).

3.4.6 IMD MIX RATIO
(requires option 002)

DESCRIPTION

Selects IMD HF:LF amplitude ratio setting. Valid choices include 1:1, 1:2, 1:4, and 1:10.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
1:1	35.1 **SPCL**	IMRATIO 1:1	35.1SP
1:2	35.2 **SPCL**	IMRATIO 1:2	35.2SP
1:4	35.4 **SPCL**	IMRATIO 1:4	35.4SP
1:10	35.10 **SPCL**	IMRATIO 1:10	35.10SP

DEFAULT SETTING

See notes.

ANNUNCIATION

The current IMD ratio setting will be displayed on the front panel left display when Special Function 35.0 is selected. Refer to 3.6.3.

Special Function 35 status is not maintained (i.e., entering any of the above described options will not affect special function status as displayed by the **SPCL FUNCTION** LED).

Serial Port header: IMDRAT

NOTES

IMD ratio is automatically set to 1:4, whenever the SMPTE type IMD measurement is selected, and to 1:1, whenever any other type of measurement is selected.

During IMD SMPTE type measurement, if the calculated HF level is not in the correct range (as measured internally at the output of the HF recovery circuit), measurement will be aborted and error 29, "IMD Mismatch", reported. Refer to 3.10.7.

The mix ratio affects both the generator and the analyzer. If the instrument is the source of the test signal for the device under test, the analyzer will be set up correctly. If the test signal is coming from another source (or is not performed in real time), set the ratio to that of the signal being analyzed. Failure to observe this may lead to Error 29 "IMD Mix Mismatch."

3.4.7 OUTPUT ENABLE

DESCRIPTION

Disabling output turns off both the A and the B outputs while enabling output reconfigures the A and B outputs according to the currently selected output configuration. Refer to 3.4.11.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Disable	-OUTPUT- **ON/OFF**	OUTENBL OFF	O0
Enable	-OUTPUT- **ON/OFF**	OUTENBL ON	O1

Front Panel key alternates ON and OFF

DEFAULT SETTING

Output disabled

ANNUNCIATION

If the output is enabled it will be annunciated by the - OUTPUT- **ON** LED.

Serial Port header: OUTPUT

NOTES

When the output is disabled, the output attenuator is disconnected from the power amplifier and terminated in a way that provides no disturbance to the output impedance. The oscillator is not disabled unless a zero source amplitude is specified to avoid the delays caused by oscillator turn on settling when switching the output.

3.4.8 OUTPUT REFERENCE

DESCRIPTION

Selects ground or floating output reference.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Ground	-OUTPUT- **GND/FLOAT**	OUTREF GROUND	OG
Float	-OUTPUT- **GND/FLOAT**	OUTREF FLOAT	OF
-OUTPUT- **GND/FLOAT** key alternates between ground and float.			

DEFAULT SETTING

Grounded

ANNUNCIATION

Grounded output is displayed by -OUTPUT- **GND** LED.

Serial Port header: OUTREF

NOTES

The "grounded" output reference connects the output reference point (the "low" terminal when unbalanced, the "center tap" (electrical) or "sleeve" (mechanical) terminal when balanced) to the analyzer analog common through a protective network.

The floating mode galvanically isolates the output common from the analyzer common and chassis.

3.4.9 OUTPUT IMPEDANCE & STRUCTURE
(requires option 001)

DESCRIPTION

Selects main source output impedance and structure. Valid options include 600 Ohms (balanced), 150 Ohms (balanced), and 50 Ohms (unbalanced).

PROCEDURE

OPTIONS	FRONT PANEL	SERIAL	GPIB
600 Ohms	-OUTPUT- **Rsource**	OUTIMP IMP600	P0
150 Ohms	-OUTPUT- **Rsource**	OUTIMP IMP150	P1
50 Ohms	-OUTPUT- **Rsource**	OUTIMP IMP50	P2

-OUTPUT- **Rsource** is a "rotary" key which selects impedance in the following order:
600 Ohms - 150 Ohms - 50 Ohms - 600 Ohms, etc.

DEFAULT SETTING

600 Ohms

ANNUNCIATION

Current status always displayed by -OUTPUT- **150 Ohms**, [600 Ohms], and **50 Ohms** LEDs.

Serial Port header: OUTSTS

NOTES

Changing the source structure will cause the source amplitude to be recalculated. The sequence taken avoids the application of higher than specified voltages appearing at the output terminals.

Inserting a plug in the ring-tip-sleeve (balanced) jack will disconnect the BNC (unbalanced) jack independent of the source structure. If the balanced structure is specified and there is no plug present in the balanced jack, a signal of half the programmed source amplitude will appear at the unbalanced BNC connector.

3.4.10 OUTPUT LOAD IMPEDANCE REFERENCES

DESCRIPTION

Selects power (dBm) and level (dBV, V) output load impedance references. In both cases, level and power, valid options range from 1 to 9999 ohms. In the case of level reference, however, the selection of 9999 ohms assumes a load impedance of infinity. Refer to 3.4.1.

PROCEDURE

LEVEL output load impedance reference is selected by special function 4 and is entered in the form 4.nnnn where nnnn is an integer value in the range 1 to 9999 and is the special function designator for the port.

POWER output load impedance reference (dBm) is selected as above except that special function 5 is used.

EXAMPLES	FRONT PANEL	SERIAL	GPIB
Level, 600 ohms	4.600 **SPCL**	4.600 SP	4.600 SP
Level, infinity	4.9999 **SPCL**	4.9999 SP	4.9999SP
Power, 800 ohms	5.800 **SPCL**	5.800 SP	5.800 SP

DEFAULT SETTINGS

Level output impedance reference = infinity
Power output impedance reference = 600 ohms

ANNUNCIATION

Currently selected level and power output impedance references will be displayed on the Front Panel amplitude display when special functions 4.0 and 5.0 are entered, respectively.

Serial Port headers : OIRL (level) and OIRP (power)

NOTES

Whenever output load impedance reference is selected, source amplitude is reset. This may result in a source amplitude "Out Of Range" (error 7) and leave an incongruity between programmed source amplitude and the actual fine output attenuator settings. Refer to the description of source amplitude maximum level in 3.4.1 before modifying output reference impedance.

The output load impedance references are used exclusively in determining source amplitude setting and have no effect on input impedance references used to display measurement data in power units.

3.4.11 OUTPUT CONFIGURATION

DESCRIPTION

Selects A and B output configuration. Valid choices include A output only, B output only, both A and B outputs, and A and -B outputs. If output is currently disabled (refer to 3.4.7), only the programmed output configuration may be modified, i.e. both A and B outputs will remain disabled. If output is subsequently enabled, the programmed output configuration will be implemented. Note that for Output B to be operational, the 5500 must be equipped with option 007.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
A only	-OUTPUT- **A/B/-B**	OUTCNF A	C0
B only *	-OUTPUT- **A/B/-B**	OUTCNF B	C1
A & B *	-OUTPUT- **A/B/-B**	OUTCNF A & B	C2
A & -B *	-OUTPUT- **A/B/-B**	OUTCNF A & -B	C3

* requires option 007

-OUTPUT- **A/B/-B** is a "rotary" key which selects output configuration in the following order: A only - B only - A & B - A & -B - A only.

DEFAULT SETTING

The default output configuration is A only, however, all outputs will be disabled due to the default state of Output Enable.

ANNUNCIATION

Current status always displayed by the -OUTPUT- **A, B,** and **-B** LEDs.

Serial Port header: OUTCNF

NOTES

Input Select includes the choice of A output and B output. Refer to 3.2.1.

3.4.12 POWER AMP SOURCE SELECT

DESCRIPTION

This function allows the user to specify the source which will be used as the input to the power amp module and therefore the Generator Output signal.

DEFAULT SETTING

Wide and narrow band level modes: internal fixed frequency sine

THD + N mode : Internal fixed frequency sine

SMPTE IMD mode : Internal fixed frequency SMPTE IMD composite signal

CCIF IMD mode : Internal fixed frequency CCIF IMD composite signal

ANNUNCIATION

None

NOTES

Any time the instrument FUNCTION is changed, the default source is automatically selected.

Certain sources can be invalid in certain modes and may produce errors.

PROCEDURE

The power amp source is selected by invoking Special Function 14 with the appropriate operand.

CHOICES *	FRONT PANEL	SERIAL	GPIB
No source	14.0 **SPCL**	14.0 SP	14.0 SP
Fixed freq. sine	14.1 **SPCL**	14.1 SP	14.1 SP
Fixed freq. IMD (composite signal) (requires option 002)	14.2 **SPCL**	14.2 SP	14.2 SP
Swept sine (requires option 054)	14.3 **SPCL**	14.3 SP	14.3 SP
External source	14.4 **SPCL**	14.4 SP	14.4 SP
External HF source for IMD (requires option 002)	14.5 **SPCL**	14.5 SP	14.5 SP
Swept HF IMD (composite signal) (requires options 002 & 054)	14.6 **SPCL**	14.6 SP	14.6 SP
Square wave (requires option 201)	14.7 **SPCL**	14.7 SP	14.7 SP
AUX Source 1 (requires option 003)	14.8 **SPCL**	14.8 SP	14.8 SP
AUX IMD source (requires option 002)	14.9 **SPCL**	14.9 SP	14.9 SP
Source 2 (requires option 003)	14.10 **SPCL**	14.10 SP	14.10 SP
AUX Source 3 (requires option 003)	14.11 **SPCL**	14.11 SP	14.11 SP
AUX Source 4 (requires option 003)	14.12 **SPCL**	14.12 SP	14.12 SP

* NOTE: All operands except 1 require that certain optional features be resident in the 5500 frame.

3.4.13 DC UTILITY DACs
(requires option 008)

DESCRIPTION

This function allows the user to control two general purpose eight bit multiplying digital to analog converters.

PROCEDURE

The Special Function code is entered followed by a decimal value representing the byte which will be sent to the DAC.

CHOICES	FRONT PANEL	SERIAL	GPIB
Set DAC A	86.nnn **SPCL**	86.nnn SP	86.nnnSP
Set DAC B	87.nnn **SPCL**	87.nnn SP	87.nnnSP

Where nnn represents a decimal number in the range of 0-255.

DEFAULT SETTINGS

Both DACs are set to 0 (see warning).

ANNUNCIATION

None.

NOTES

The two DACs provide user controllable analog output signals. Each DAC is provided with complementary outputs such that the voltage appearing on the main output is multiplied by -1 on the complementary output. The DACs may be configured by the user to operate in either an unsigned binary or an offset binary mode. The DACs' reference inputs may be connected to an internal precision reference voltage or their reference inputs may be derived from external signals. The user may modify the scale factor by changing the value of a single resistor for each DAC.

WARNING

If either DAC is configured for offset binary operation, the default value for that DAC will cause the main and complement outputs to go to their negative and positive full scale values, respectively. There is no way explicitly provided to avoid this condition.

3.4.14 DC MULTIPLEXER CONTROL
(requires option 008)

DESCRIPTION

This function provides a one of eight multiplexer utility.

PROCEDURE

The Special Function code is followed by the designation of the required output.

CHOICES	FRONT PANEL	SERIAL	GPIB
Set mux	88.n **SPCL**	88.n SP	88.nSP

Where n is the designated output to select in the range of 0 to 8.
0 represents all outputs off.

DEFAULT SETTINGS

All outputs off.

ANNUNCIATION

None.

NOTES

The outputs provided are mutually exclusive active high logic signals that can provide a fan out of five TTL unit loads. The user is expected to provide the jumpers on the DC and digital module to connect the outputs in such a way as to perform the desired control.

This function is usually used in conjunction with other resources on the DC and digital module. For example, it may be used to drive some of the utility relays to provide an analog mux-demux facility. Software provides delays between the actuation of the various outputs so that a non-overlap time longer than that required for any on-board relays can be expected. For loads that might be damaged by an overlap condition lasting less than a few milliseconds, however, it is advisable to provide protection in the form of cascaded relay configurations. The user has complete freedom as to which outputs are to be used for what purpose.

3.4.15 DC DIGITAL UTILITY
(requires option 008)

DESCRIPTION

This function provides the user with an eight bit TTL latched output port.

PROCEDURE

The Special Function code is followed by the decimal value that represents the desired bit pattern.

CHOICES	FRONT PANEL	SERIAL	GPIB
Set bits	89.nnn **SPCL**	89.nnn SP	89.nnnSP

Where nnn represents the decimal number in the range of 0 to 255.

DEFAULT SETTINGS

ANNUNCIATION

None.

NOTES

The user is responsible for defining the application of this utility. The bits in the output register may be defined as affecting one or several separate distinct circuit functions, but it should be noted that there is no way to read the current state of the port internally. It is thus necessary for the user to remember which bits were set in an independent application and modify them as required.

Although it may seem inconvenient to refer to bit patterns by decimal values, any other data format would have been inconsistent with the existing special function operand processor. It is thought that the high degree of flexibility provided more than offsets any inconvenience of use.

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3.5 DISPLAY FORMATTING

3.5.1 RELATIVE MODE

DESCRIPTION

When the relative mode is enabled, the ratio of measured level or distortion to a specified reference is displayed; when disabled, the actual measured level or distortion is displayed.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Disable	**RELATIVE**	RATIO OFF	R0
Enable using previous reference	**RELATIVE**	RATIO OLD	R1
Enable and set shift reference to last measured value	**RELATIVE**	RATIO NEW	11.4SP

- The **RELATIVE** key alternates between disable and enable, using currently stored reference.
- Closure of the shift of **RELATIVE** always attempts to enable relative mode with the last measured value.

DEFAULT SETTING

Relative mode disabled

ANNUNCIATION

Current relative mode status is always displayed by Front Panel **REL** LED. Further, if no other special function is in effect and the relative mode is disabled then the **SPCL FUNCTION** LED will turn off. If the relative mode is enabled, the **SPCL FUNCTION** LED will turn on.

Current reference will be displayed on the left display by Special Functions 11.1 or 11.2. Refer to 3.5.2 and 3.6.3.

Serial Port header: RATIO

NOTES

Two different relative references are always maintained, a distortion reference and a level reference. If the relative mode is enabled then whenever valid measurement data is available, the ratio of measured level to the current level reference will be calculated and displayed; in the case of distortion type measurement, the ratio of measured distortion to the current distortion reference will be calculated and displayed.

If relative mode is disabled, or enabled using the **RELATIVE** key, the RATIO OLD or R1 commands, the currently stored references remain unchanged. If relative mode is enabled via Special Function 11.4 and level type measurement is in effect then the level reference is reset to the last valid level measurement result while the distortion reference remains unchanged. Similarly, if a distortion type measurement is in effect, the distortion reference is reset to the last valid distortion measurement result while the level reference remains unchanged.

References may be changed at any time by selecting relative reference numeric entry mode and entering a new value. If a distortion type measurement is in effect then only the distortion reference may be modified. Similarly, if a level type measurement is in effect, only the level reference may be modified. Refer to 3.5.2.

Relative values are displayed in % or dB units depending on whether linear or log amplitude display mode is currently selected.

If the relative mode is enabled while a level type measurement is in effect and then a distortion type measurement is selected, the relative mode will be automatically disabled. If the relative mode is enabled while a distortion type measurement is in effect and then a level type measurement is selected, the relative mode will be automatically disabled. Refer to 3.3.1.

When the relative mode is disabled while measuring level then the last specified absolute amplitude display units will be restored unless display mode has been modified, in which case, the appropriate log or linear version of the last specified absolute units will be selected. This will not affect distortion units as they can only be in dB or %.

This function is disabled during DC Volts* or Phase* type measurements. Note that if changes are made to this function while either DC Volts or Phase measurement modes are selected, the display mode will be unaffected until an AC measurement mode is selected.

***NOTE**: DC Volts and Phase Measurement require options 008 and 009 respectively.

3.5.2 RELATIVE MODE REFERENCE

DESCRIPTION

Selects new relative reference value, either distortion or level, depending on whether the currently selected measurement is distortion or level.

METHODS AVAILABLE

First select the Relative Reference numeric entry mode then use one of the following methods to set the new value:

CHOICES	FRONT PANEL	SERIAL	GPIB
SET "REFERENCE" MODE	**[REFERENCE]**	**REF**	**RE**
Enter new value:			
e.g.(level) 2.5 Volts	**2.5 V**	2.5 V	2.5VL
Valid units: for level	**V, dBV, dBm**	V,MV,UV,DBM, DBV	VL,MV,UV, DM,DV
e.g.(distortion) 2.5%	**2.5 %**	2.5 %	2.5PE
Valid units: for distortion	**%, dB**	%,DB	PE,DB
Set to last valid level or distortion measurement	*	DUP	-
- Relative reference may also be automatically stored when relative mode is enabled. Refer to Section 3.5.1.			

DEFAULT SETTING

Distortion reference is 100 %

Level reference is 1 V

ANNUNCIATION

Reference numeric entry mode is in effect if the **RELATIVE REFERENCE** LED is on.

If a level type measurement is in effect, the currently selected level reference will be displayed on the amplitude display if the **RELATIVE REFERENCE** key is held; if a distortion type measurement is in effect, the current distortion reference will be displayed when the **RELATIVE REFERENCE** key is held. Refer to 3.6.2.

Regardless of the type of measurement in effect, the currently selected level reference will be displayed whenever Special Function 11.1 or serial port command, RATIO DSPL, is entered. The currently selected distortion reference will be displayed whenever Special Function 11.2 or serial port command, RATIO DSPD, is entered. Refer to 3.6.3.

Serial Port headers are: DSTREF and LVLREF

NOTES

There are no limits on the choice of distortion and level references.

While the relative mode is enabled and whenever valid measurement data is available, the ratio of measured level or distortion to the currently stored level or distortion reference will be calculated and displayed.

If the relative mode is enabled using Special Function 11.4 or the serial port command, RATIO NEW, the reference to be used will be automatically set to the last valid distortion or level measurement result. Refer to 3.5.1.

This function is disabled during DC Volts* or Phase* type measurements. Note that if changes are made to this function while either DC Volts or Phase measurement modes are selected, the display mode will be unaffected until an AC measurement mode is selected.

***NOTE**: DC Volts and Phase Measurement require options 008 and 009 respectively.

3.5.3 AMPLITUDE DISPLAY LIN/LOG FORMAT

DESCRIPTION

Enables the amplitude display values to be expressed in either linear or logarithmic units.

PROCEDURE

OPTIONS	FRONT PANEL	SERIAL	GPIB
Linear units	**LIN/LOG**	LIN	LN
Log units	**LIN/LOG**	LOG	LG
- The **LIN/LOG** key alternates between selecting linear and log units.			

DEFAULT SETTING

Linear units

ANNUNCIATION

The current lin/log status is not explicitly annunciated as such on the Front Panel or serial port. It is however evident in the selection of units in which data is expressed on the amplitude (left) display and the serial port AMP display.

NOTES

If a distortion type measurement is in effect or the relative mode is enabled and the linear units mode selected, measurement results will be expressed in % units. If log units are selected, measurement results will be expressed in dB units. If a level type measurement is in effect and the relative mode is disabled and linear units are selected, measurement results may be expressed in V, mV, µV, W, mW, or µW units. If log units are selected, measurement results may be expressed in dBV or dBm units. The choice of voltage or power units depends on the currently selected amplitude display units. Refer to 3.5.4.

If the amplitude display operating mode is in the fixed mode (see Section 3.5.4) and the lin/log status is changed, the operating mode will be automatically reset to the floating mode.

If the amplitude display is in linear mode and log units are specifically selected by any of the functions described by Section 3.5.4, the log mode is automatically enabled. Similarly, if the log mode is currently enabled and linear units are selected then the linear mode will be automatically enabled.

When switching between linear and log power units, the appropriate impedance reference is selected for Watts or dBm. Refer to 3.5.6.

The choice of linear or log display modes also affects special amplitude displays. Refer to 3.6.2 and 3.6.3.

The effect of amplitude display mode on the GPIB output data format is explained in Section 3.8.1.

This function is disabled during DC Volts* or Phase* type measurements. Note that if changes are made to this function while either DC Volts or Phase measurement modes are selected, the display mode will be unaffected until an AC measurement mode is selected.

***NOTE**: DC Volts and Phase Measurement require options 008 and 009 respectively.

3.5.4 AMPLITUDE DISPLAY UNITS AND OPERATING MODE

DESCRIPTION

Enables floating or fixed operation and selects units in which measurement data is expressed on the Front Panel amplitude display and the serial port AMP display. It will also affect GPIB output data. Decimal point position is not affected.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Float V	**UNITS**	AMPFRMT V	VO
Float W	**UNITS**	AMPFRMT W	WA
dBV	**UNITS**	AMPFRMT DBV	BV
dBm	**UNITS**	AMPFRMT DBM	BM
Float current selected units:	30.0 **SPCL**	AMPUNIT FLOAT	30.0SP
Hold current selected units:	30.1 **SPCL**	AMPUNIT HOLD	30. 1SP
Hold V	30.2 **SPCL**	AMPUNIT V	30.2SP
Hold mV	30.3 **SPCL**	AMPUNIT MV	30.3SP
Hold μV	30.4 **SPCL**	AMPUNIT UV	30.4SP
Hold W	30.5 **SPCL**	AMPUNIT W	30.5SP
Hold mW	30.6 **SPCL**	AMPUNIT MW	30.6SP
Hold μW	30.7 **SPCL**	AMPUNIT UW	30.7SP

If a distortion type measurement is in effect or the relative mode is enabled, the **UNITS** key has no effect; otherwise, if the linear mode is enabled, the **UNITS** key alternates between V and W and if the log mode is enabled, it alternates between dBV and dBm.

DEFAULT SETTING

Floating V

ANNUNCIATION

The currently selected units are displayed by the units LEDs of the amplitude display. If floating units operating mode is selected and no other special function is in effect then the **SPCL FUNCTION** LED is turned off. If the hold units operating mode is selected, the **SPCL FUNCTION** LED is turned on.

Serial Port header: AUNITS

NOTES

If floating units operating mode is enabled and the selected units are V or W then the amplitude display data will be expressed in V, mV, and μV or W, mW, and μW, depending on data fit.

Selecting units using any of the above commands, except special function 30.1 through 30.7 or AMPUNIT HOLD through UW, automatically enables floating units operating mode.

If the currently selected units are V, mV or μV and log mode is enabled, dBV units and float operating mode will be automatically selected. If the currently selected units are W, mW or μW and log mode is enabled, dBm units and float operating mode will be automatically selected. See Section 3.5.3.

If the currently selected units are V, mV, μV, W, mW, or μW and a distortion type measurement is selected or the relative mode is enabled then % units and the float operating mode will be selected. If the currently selected units are dBV or dBm and a distortion type measurement is selected or the relative mode is enabled then dB units and the float operating mode will be selected. If the log mode is enabled and linear units are specifically selected, the linear mode will be automatically enabled. Similarly, if the linear mode is enabled and log units are specifically selected then the log mode will be automatically enabled. See 3.5.3.

When switching between linear and log power units, the appropriate impedance reference is automatically selected. Refer to 3.5.6.

Special displays will be expressed in currently selected units if possible. Refer to 3.6.2 and 3.6.3.

The effects of amplitude display mode on the GPIB output data format is explained in Section 3.8.1.

If units are being held, measurement data and special displays may overflow and a "Level/distortion display overflow" (error 42) may be generated.

This function is disabled during DC Volts* or Phase* type measurements. Note that if changes are made to this function while either DC Volts or Phase measurement modes are selected, the display mode will be unaffected until an AC measurement mode is selected.

***NOTE**: DC Volts and Phase Measurement require options 008 and 009 respectively.

3.5.5 AMPLITUDE DISPLAY DECIMAL POINT POSITION & OPERATING MODE

DESCRIPTION

Selects floating or fixed decimal point and fixed decimal point position on amplitude display.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Float	31.0 **SPCL**	AMPDPNT FLOAT	31.0SP
Hold current position	31.1 **SPCL**	AMPDPNT HOLD	31.1SP
Hold DDDDD.	31.2 **SPCL**	AMPDPNT DDDDD.	31.2SP
Hold DDDD.D	31.3 **SPCL**	AMPDPNT DDDD.D	31.3SP
Hold DDD.DD	31.4 **SPCL**	AMPDPNT DDD.DD	31.4SP
Hold DD.DDD	31.5 **SPCL**	AMPDPNT DD.DDD	31.5SP
Hold D.DDDD	31.6 **SPCL**	AMPDPNT D.DDDD	31.6SP
Hold .DDDDD	31.7 **SPCL**	AMPDPNT .DDDDD	31.7SP

DEFAULT SETTING

Floating decimal point

ANNUNCIATION

If floating decimal point is selected, the **SPCL FUNCTION** LED should turn off. If any of the hold options is selected and if no other special function is in effect, the **SPCL FUNCTION** LED should turn on.

Serial Port header: ADPNT

NOTES

If the decimal point is being held, measurement data and special displays may overflow and "Level/distortion display overflow" (error 42) will be produced.

3.5.6 IMPEDANCE REFERENCES FOR WATTS AND dBm

DESCRIPTION

Selects impedance references in the range of 1 to 999 Ohms for measured amplitude display data expressed in Watts or dBm power units.

PROCEDURE

The Watts impedance reference is selected by Special Function 25 and is entered in the form 25.nnn(n) , where nnn(n) is an integer value in the range 1 to 999 (9999) and is the special function designator for the port. Due to size restrictions of data entry display, the maximum value for the dBm or Watts impedance reference from the front panel is 999 while impedances entered via the GPIB or Serial Ports can take values up to 9999.

The dBm impedance reference is entered as above except that special function 26 is used.

EXAMPLES	FRONT PANEL	SERIAL	GPIB
Watts imp. = 10 Ohms	25.10 **SPCL**	25.10 SP	25.10SP
dBm imp. = 800 Ohms	26.800 **SPCL**	26.800 SP	26.800SP

DEFAULT SETTING

dBm impedance = 600 Ohms

Watts impedance = 8 Ohms

ANNUNCIATION

Currently selected Watts and dBm impedance references will be displayed on the Front Panel amplitude display when special functions 25.0 and 26.0 are entered, respectively.

Serial Port headers: WTSIMP and DBMIMP

3.5.7 FREQUENCY DISPLAY DECIMAL POINT POSITION & OPERATING MODE

DESCRIPTION

Selects floating or fixed decimal point and fixed decimal point position on frequency display.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Float	32.0 **SPCL**	FRQDPNT FLOAT	32.0SP
Hold current position	32.1 **SPCL**	FRQDPNT HOLD	32.1SP
Hold DDDDD.	32.2 **SPCL**	FRQDPNT DDDDD.	32.2SP
Hold DDDD.D	32.3 **SPCL**	FRQDPNT DDDD.D	32.3SP
Hold DDD.DD	32.4 **SPCL**	FRQDPNT DDD.DD	32.4SP
Hold DD.DDD	32.5 **SPCL**	FRQDPNT DD.DDD	32.5SP
Hold D.DDDD	32.6 **SPCL**	FRQDPNT D.DDDD	32.6SP
Hold .DDDDD	32.7 **SPCL**	FRQDPNT .DDDDD	32.7SP

DEFAULT SETTING

Floating decimal point

ANNUNCIATION

If the floating decimal point is selected, the **SPCL FUNCTION** LED should turn off. If any of the hold options is selected and if no other special function is in effect, the **SPCL FUNCTION** LED should turn on.

Serial Port header: FDPNT

NOTES

If the decimal point is being held, measurement data and special displays may overflow and "Frequency display overflow" (error 50) will be generated.

This function is disabled during DC Volts* or Phase* type measurements. Note that if changes are made to this function while either DC Volts or Phase measurement modes are selected, the display mode will be unaffected until an AC measurement mode is selected.

***NOTE**: DC Volts and Phase Measurement require options 008 and 009 respectively.

3.6 FRONT PANEL DISPLAY COMMANDS

3.6.1 CLEAR FRONT PANEL DISPLAYS AND ERRORS

DESCRIPTION

This command clears the front panel displays, fatal error conditions, and disables any special displays currently in effect. If the instrument is in hold or trigger measurement mode, the clear command will also trigger a measurement.

PROCEDURE

COMMAND	FRONT PANEL	SERIAL	GPIB
clear displays	**CLR**	CLEAR	CL

NOTES

The clear command may be used to clear any numeric entry in progress on the Front Panel without generating a syntax error, to clear a fatal error condition, to return the instrument to normal operating mode (i.e. measuring), and to disable any special Front Panel displays that are currently enabled (see 3.6.3 below).

If the instrument is in hold or trigger measurement mode, the clear command will also cause a single measurement to be performed. Refer to 3.8.4.

In remote mode all Front Panel keys, except the **CLR** and **LCL** keys, are disabled. If LLO bus command is detected, the instrument will go into remote with lockout state in which case all the Front Panel keys will be disabled. If the instrument is then returned to local mode, other than by the REM line going false, the **LCL** key will remain locked out and the **CLR** key will be locked out from triggering measurement but will remain otherwise functional.

3.6.2 DISPLAY CURRENT STATUS
(Using the Parameter Keys)

DESCRIPTION

The same Front Panel keys that select numeric entry mode (see 3.1.1 and 3.1.5), if held, will display the current status of the associated parameter on the appropriate Front Panel display. The display is cleared when the key is released.

DISPLAY PARAMETER	FRONT PANEL
Source frequency	hold **FREQUENCY**
Source frequency increment	**SHIFT** & hold **FREQUENCY**
Source amplitude	hold **AMPLITUDE**
Source amplitude increment	**SHIFT** & hold **AMPLITUDE**
IMD offset frequency	hold **IMD LOW FREQUENCY**
Relative reference	hold **RELATIVE REFERENCE**

NOTES

When a parameter key is held, the numeric entry mode may also be modified as described in Section 3.1.5.

The current status of the parameter that is displayed is the programmed value as opposed to the actual or measured value. Not all numeric entry parameters may be viewed in this way (i.e. SVF frequency and SVF frequency increment). Source amplitude, amplitude increment and relative references will always appear on the amplitude (left) display, the others on the frequency (right) display.

The displayed status will be expressed in currently selected units if possible.

When the parameter key is released, the associated display will resume whatever it was doing before except in the case of fatal error, in which case, the fatal error condition will have been cleared by reselecting numeric entry mode. In the case of relative reference display, if the current type of measurement is distortion, the distortion reference will be displayed, otherwise the level reference will be displayed.

3.6.3 SPECIAL FRONT PANEL DISPLAYS

DESCRIPTION

Displays current status of the specified parameter on the Front Panel amplitude and/or frequency display.

PROCEDURE

PARAMETER(S)	FRONT PANEL	SERIAL	GPIB
Source amplitude and frequency	10 **SPCL**	10 SP	10SP
Distortion relative reference	11.2 **SPCL**	RATIO DSPD	11.2SP
Level relative reference	11.1 **SPCL**	RATIO DSPL	11.1SP
Watts impedance	25.0 **SPCL**	25.0 SP	25.0SP
dBm impedance	26.0 **SPCL**	26.0 SP	26.0SP
GPIB status	-GPIB- **ID?**	21.0 SP	21.0SP
IMD mix ratio *	35.0 **SPCL**	35.0 SP	35.0SP
Level output load impedance reference	4.0 **SPCL**	4.0 SP	4.0SP
Power output load impedance reference	5.0 **SPCL**	5.0 SP	5.0SP

*IMD Function requires option 002.

DEFAULT SETTING

All special displays disabled.

NOTES

Any of the above special displays may be disabled by the clear command or by selecting another special display. They may also be temporarily interrupted by numeric entry, held parameter key display, or fatal error display.

The current status of the parameter that is displayed is the programmed value as opposed to the actual or measured value.

Only the source frequency and IMD* offset frequency use the right display; all other special displays use only the left display.

The displayed status will be expressed in currently selected units if possible.

The GPIB status shows the current address that the GPIB interface is set to respond to as well as some details of the talk-only and listen-only status. Refer to Section 3.8.7.

***NOTE**: IMD Function requires option 002.

3.7 STORE AND RECALL COMMANDS

3.7.1 STORING CURRENT MACHINE STATE

DESCRIPTION

Stores the current machine state in non-volatile RAM, excluding I/O and calibration status, and assigns to it the specified store number which may then be used with the full or partial recall commands to recover the machine state. The store numbers which may be used are 2 through 11. Store numbers 0 and 1 are reserved for default and power-down machine states and may not be used with this function.

PROCEDURE

The entire machine state is preserved by entering an integer in the range 2 to 11 followed by the <STORE>command for the front panel and GPIB and the reverse for the serial port.

EXAMPLE	FRONT PANEL	SERIAL	GPIB
Save in 5	5 **STORE**	STORE 5	5ST

NOTES

The statuses which are saved by the store command are the same as those which comprise default machine state and are listed in Section 3.12.4.

Any machine states saved previously using the same store number will be lost.

Power-down machine state refers to the machine state that was automatically saved in store 1 during the last powering down of the instrument. The information in store 1 is over-written whenever the full machine state is recalled. Refer to Section 3.7.3.

The information is stored in non-volatile RAM along with a checksum to guarantee the integrity of the stored data. A write to store 1 is initiated at power down and requires some time to be successfully completed. It is possible that heavily loaded systems operating with a low line condition may not have enough time to finish the operation before the power supply falls out of spec and aborts all processor activity. It is for this reason that the recommended procedure for powering down the instrument is by the front panel power switch instead of an external line interruption.

3.7.2 RECALLING PARTIAL MACHINE STATE

DESCRIPTION

Recalls only source amplitude and frequency settings of the machine state associated with the specified store number. Store 0 (default machine state) and store 1 (power-down machine state) may always be used with this command. If a store command has previously assigned a machine state to store 2 through 11 then store numbers 2 through 11 may also be used.

PROCEDURE

The partial machine state is recalled by entering the number of the desired store followed by the <RECALL> command for the front panel and GPIB and the reverse for the serial port.

EXAMPLE	FRONT PANEL	SERIAL	GPIB
Recall 5	5 **RECALL**	RECPART 5	5RC

NOTES

To specify partial recall from the Front Panel always use the 0 suffix or no suffix at all; to specify full recall always use the 1 suffix. Refer to 3.7.3 below.

Power-down machine state refers to the machine state that was automatically saved in store 1 during the last powering down of the instrument or the last full machine state recall.

Using an invalid store number or attempting to recall a store which has not previously been saved will result in an "Invalid Command Operand" (error 6).

The information which is recalled is checked for validity with a three byte checksum. It is virtually inconceivable that invalid data could be used to reprogram the instrument.

3.7.3 FULL MACHINE STATE RECALL

DESCRIPTION

Recalls full machine state associated with the specified store number. Store 0 (default machine state) and store 1 (power-down machine state) may always be used with this command. If a store command has previously assigned a machine state to store 2 through 11 then store numbers 2 through 11 may also be used.

PROCEDURE

The full machine state is recalled by entering the desired store number with a ".1" suffix followed by the <RECALL> command for the front panel or the GPIB. The serial port only requires the <RECFULL>command and the store number to effect the recall.

EXAMPLE	FRONT PANEL	SERIAL	GPIB
Recall 5	5.1 **RECALL**	RECFULL 5	5.1RC

NOTES

All of the user specified generation and measurement functions of the instrument at power down can be recovered by recalling store 1.1. In all cases except for store 1, the current state is automatically saved in store 1 prior to recalling the entire machine state, overwriting the state from the last power down. Thus store 1 can also be used to recall the state immediately prior to the last full recall.

To specify partial recall from the Front Panel always use the 0 suffix or no suffix at all; to specify full recall always use the 1 suffix. Refer to 3.7.2.

Full machine state recall will not affect I/O or calibration status, which are never stored. Note particularly that the serial port status is not affected.

Using an invalid store number or recalling a store which has not previously been saved will result in an "Invalid Command Operand" (error 6).

The information which is recalled is checked for validity with a three byte checksum. It is virtually inconceivable that invalid data could be used.

3.7.4 DEFAULT POWER-UP MACHINE STATE

DESCRIPTION

Selects the machine state which is to be recalled on the next and subsequent power ups. Choices include the default and the power down machine states.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Default State	23.0 **SPCL**	23.0 SP	23.0SP
Power Down State	23.1 **SPCL**	23.1 SP	23.1SP

NOTES

Entering Special Function 23 will not affect the current machine state. The next time the instrument is powered up, it will be initialized to the default machine state as described by 3.12.4, if the default option of Special Function 23 was selected (23.0). If the power down option of Special Function 23 was selected (23.1), the instrument will be initialized to its last power-down state.

Power-down state refers to the machine state that was automatically saved in store 1 during the last powering down of the instrument. If the automatic saving of machine status on the last power down was unsuccessful and store 1 is invalid, the instrument will recall the default machine state on power up.

3.8 GPIB CONTROL COMMANDS

3.8.1 GPIB IMPLEMENTATION NOTES (See also Section 4, Application Notes)

DESCRIPTION

On power up, a path is opened to the GPIB port using the 5500 internal GPIB device descriptor module, "B0." If neither the address nor the talk and listen status have been redefined, the descriptor module resides in the system ROM, otherwise B0 resides in non-volatile RAM. If the address and talk and listen status indicate 'Interface Not Installed' condition then no path is opened. Otherwise the software always attaches the device and opens a path to it.

DEVICE ADDRESS

The GPIB address by which the instrument is identified on the bus is stored in the internal descriptor module. It may be modified by Special Function 33 to any value in the range 0 to 31. Refer to Section 3.8.7.

TALK AND LISTEN STATUS

The devices talk and listen status flags are stored in the internal descriptor module. They may be modified by Special Function 34. Refer to Section 3.8.7.

GPIB OPERATING MODE

The device address and talk and listen status determine the operating mode of the GPIB interface as follows:

ADDRESS	TALK FLAG	LISTEN FLAG	GPIB OPERATING MODE
=31	NA	NA	Interface Not Installed
<31	true	true	Talk Only
<31	true	false	Talk Only
<31	false	true	Listen Only
<31	false	false	Talk and Listen

GPIB OPERATING MODES (Interface Not Installed)

The GPIB device remains inactive i.e., the instrument will not communicate with any remote GPIB devices.

GPIB OPERATING MODES (Talk Only)

In this mode, the instrument is configured to send data messages whenever the bus is in data mode. In free-run measurement mode, data messages are written to the GPIB driver's output buffer only if the output buffer is empty. If either of these conditions does not hold, the data will be lost. Refer to 'Sending Data Messages'.

The instrument does not respond to any other GPIB bus commands or accept any data messages (e.g. it can't be addressed to listen).

The instrument will issue a Request for Service whenever any of the specified conditions hold and always on GPIB command input error. Refer to 'SRQ Implementation' below.

GPIB OPERATING MODES
(Listen Only)

In this mode, the instrument responds to DCL, LLO and GET bus commands but not to GTL, REN, IFC or a serial poll. It accepts data messages but can't send any.

GPIB OPERATING MODES
(Talk and Listen (normal operation)

In this mode, the instrument responds to bus commands, serial polls, and data messages.

In free-run measurement mode, data messages are written to the GPIB driver's output buffer only if the instrument has been addressed to talk and the buffer is empty. If either of these conditions is not true, the data will be lost. In hold or triggered measurement mode, data messages are always written to the output buffer. Refer to 'Sending Data Messages' and 'Output Buffer Overflow' below.

Once addressed to talk by the GPIB controller, the instrument then remains configured to talk until unaddressed.

The instrument will issue a Request for Service whenever any of the specified conditions is true and always on GPIB command input error. Refer to 'SRQ Implementation' below.

SENDING DATA MESSAGES

If the instrument is able to send data messages and is in free-run measurement mode (see 3.3.2), it will try to send amplitude or frequency display data to the remote device whenever data is available, the output buffer is empty and the device is addressed to talk. If any of these conditions is not true, the data will be lost.

If the instrument is able to send data messages and is in hold or triggered measurement mode, it will send amplitude or frequency display data to the remote device whenever data is available. Refer to 'Output Buffer Overflow' below.

Data is available for output to the remote device whenever amplitude measurement data, including non-fatal measurement errors and exceptions and fatal errors, are ready for display and the instrument has been configured to read the amplitude display to the GPIB or whenever frequency measurement, including non-fatal measurement errors and fatal errors, is ready for display and the instrument has been configured to read the frequency display to the GPIB. The Front Panel display which is to be read to the GPIB is selected by Special Function 20. Refer to Section 3.8.5

SENDING DATA MESSAGES

The data message sent to the GPIB listener by the 5500 is always of the form (ASCII)

SDDDDDESNNCRLF

where:

SDDDDD = signed 5-digit decimal mantissa with the decimal point presumed to be to the right of the right most digit.

E = ASCII 'E'

SNN = signed 2-digit decimal exponent

CRLF = ASCII carriage return/line feed sequence

The above floating point values are presumed to be in base units.

The value is in Volts, watts, dBm, dBV, dB, %, Hz or ohms depending on which is currently selected; mV, μV, mW, μW and kHz are always converted back to V, W or Hz. The error message sent by the GPIB is always of the form (ASCII) +900DDE+05CRLF where:

DD = 2-digit error code.

OUTPUT BUFFER OVERFLOW

In hold or triggered measurement mode, the instrument is configured to send amplitude or frequency display data to the listener, whenever data is available, as described above. The data is automatically written to the GPIB driver's output buffer and regardless of the state of the output buffer and whether or not the instrument has been addressed to talk. If the data is not subsequently read by the listener, the output buffer will overflow and the instrument will appear to lock up until the remote device reads more data from the instrument. The buffer overflows after approximately 7 data messages have been written but not read by the remote device. The instrument goes to sleep until there is sufficient room in the buffer to complete the last write to it.

SRQ IMPLEMENTATION

The SRQ conditions determine when the GPIB interface will request service from the controller on the bus.

Allowable conditions are as follows:

- On GPIB input error only
- On any fatal instrument error including GPIB code errors
- On any fatal instrument error or data ready

The data ready condition is true whenever measurement data, including non-fatal measurement errors and exceptions, are available for output.

On power up, SRQ conditions always default to 'on GPIB input error only'. The conditions may then be modified by either Special Function 22, a SDC or a DCL command from the controller. The latter two commands force the SRQ conditions to their default status.

The interface will request service only if it is in Talk Only or Talk and Listen operating mode. The GPIB decoder calls the driver's 'put status' routine with the Status Byte:

IF STATUS BYTE	**THEN CONDITION INDICATED IS**
= 1	data ready
= 2	GPIB input error in effect
= 4	fatal instrument error in effect

Only the 3 least significant bits of the Status Byte are used by the decoder to indicate the condition in effect. The driver then sets b6 of the Status Byte and issues a Request for Service. If the controller on the bus responds with a serial poll the Status Byte will be sent in response. The implementation of the driver sets the "data ready" bit, b0, in the status register as long as data is available in the output buffer. Note that this does not affect the SRQ message, as the instrument need not be in SRQS and thus will not go into APRS if polled. The user software's serial poll routine should verify that the SRQ bit is set in the response byte to see if this unit has requested service. The ability to set the data ready bit without generating a Service Request allows the controller to verify whether the output buffer is empty at the instant the status is taken.

RECEIVING MESSAGES FROM THE REMOTE GPIB CONTROLLER

VALID BUS COMMANDS

MESSAGE	RECEIVED	EFFECT
Remote	REN true & addressed	Puts the instrument in Remote and locks out all front panel keys except Clear and Local.
Local	GTL or REN false	Returns the instrument to Local state.
Set Local Lockout	LLO	Locks out front panel Clear & Local Keys.
Clear Local Lockout	REN false	Enables front panel Clear & Local Keys.
Abort	IFC	Resets GPIB interface to the idle state.
Trigger	GET	If the instrument is in triggered or hold mode, a single measurement will be initiated and its results (depending on which display is currently selected) will be output to the bus. Note: Data is output to the bus only if the instrument is capable of talking i.e., in Talk Only or Talk & Listen mode. If no one is listening, the GPIB output buffer may overflow and lock up the instrument after approximately 7 attempts to transfer data.
Clear	DCL or	Sets SRQ conditions to GPIB code error SDC only. Selects left display for reading to GPIB and resets the instrument to its default machine state.

GPIB DATA COMMANDS

GPIB commands are received when the bus is in data mode and are always in the form of ASCII strings. Refer to the individual Command Functions and to Section 3.1.2. The GPIB driver strips line feeds, carriage returns and spaces from the input data stream. This is to prevent the situation where the instrument input processor has recognized a sweep command but has not yet processed any trailing whitespace characters. Because the design of the sweep support software is such that any input detected on any port will abort the sweep, it would be possible for this whitespace to abort the sweep immediately that it is recognized. Having the driver strip these characters eliminates this problem.

3.8.2 SELECTING REMOTE/LOCAL OPERATION

DESCRIPTION

Enables or disables remote control of the instrument via the GPIB. Refer to Section 3.8.1 for description of the GPIB interface.

Following are descriptions of all possible states the instrument can achieve:

STATE	DESCRIPTION
LOCS	Normal operating mode, all Front Panel keys functional
REMS	All Front Panel keys except **CLR** and **LCL** locked out
RWLS	All Front Panel keys locked out
LWLS	Front Panel **CLR** for the purposes of triggering and **LCL** keys locked out, all other keys functional

NEW STATE	OLD STATE	REMOTE GPIB DEVICE	FRONT PANEL
REMS	LOCS	asserts REN true and addresses the instrument	
RWLS	REMS	asserts LLO	
LOCS	REMS	asserts REN false or GTL	**LCL** key
LWLS	RWLS	asserts GTL	
LOCS	RWLS	asserts REN false	

ANNUNCIATION

Current state is always displayed by the **REM** and **LLO** LEDs. If REMS or RWLS states in effect, **REM** is turned on. If RWLS or LWLS states in effect, **LLO** turned on.

Serial Port header: FPANEL

3.8.3 LOCAL LOCKOUT

DESCRIPTION

The GPIB controller may, by asserting LLO, lock out the Front Panel **CLR** and **LCL** keys. Lockout is cleared only when REN goes false. Whenever the instrument is in REMS state, all front panel keys except **CLR** and **LCL** are locked out. If LLO is asserted, the instrument goes into RWLS state, in which case all front panel keys are locked out. Once in RWLS state, if REN goes false, the instrument will enter LOCS state and all front panel keys will be restored. If, however, GTL is asserted instead, the instrument will enter LWLS state in which case all front panel keys except **CLR** and **LCL** will be restored. Refer to 3.8.1 and 3.8.2. Note that the only function the **CLR** key has in this context is that of triggering measurement.

ANNUNCIATION

Current state is always displayed by the **REM** and **LLO** LEDs. If REMS or RWLS states in effect, the **REM** LED is turned on. If RWLS or LWLS states in effect, the **LLO** LED is turned on.

Serial Port header: FPANEL

NOTES

It is generally advisable to assert LLO before addressing the instrument. This avoids the possibility that the operator could depress the **LCL** key after the instrument was addressed and before the controller has asserted LLO. It is also good practice to send the SDC or DCL message immediately after this to initialize the instrument to a known state.

3.8.4 TRIGGERING MEASUREMENT

DESCRIPTION

Initiates a single measurement attempt, if the instrument is in hold or trigger mode. Refer to 3.3.2. In hold or trigger mode, the instrument is configured to send data messages to the GPIB whenever data is available. If the messages are not subsequently read by a listener, the instrument may lock up. Refer to 3.8.1 for a description of the GPIB implementation.

METHODS

COMMAND D	FRONT PANEL	SERIAL	GPIB
Clear	**CLR**	CLEAR	CL
GET	-	-	assert GET

For the **CLR** key to be functional, the instrument must not be in local lockout i.e., RWLS or LWLS state (see 3.8.2)

NOTES

It is important to understand that triggering a measurement does not guarantee valid measurement results. The instrument could return either exceptions or errors after being triggered and the listener should check the data for these conditions. In general, it is possible to ignore exceptions and trigger another measurement but a number of consecutive errors implies that there is a problem in the test setup.

3.8.5 SELECTING FRONT PANEL DISPLAYS TO BE READ TO THE GPIB

DESCRIPTION

The GPIB interface may be configured to send either left (amplitude) or right (frequency) front panel display data. Special front panel displays are never read to the GPIB, only floating point measurement results, non-fatal measurement errors or exceptions and fatal error. Fatal error messages, which take up both displays, will be sent regardless of which display has been selected. Refer to Section 3.8.1.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
Read left display	20.0 **SPCL**	20.0 SP	RL
Read right display	20.1 **SPCL**	20.1 SP	RR

DEFAULT SETTING

Read left (amplitude) display to the GPIB.

ANNUNCIATION

If no other special functions are in effect and the read left display choice is selected, then the **SPCL FUNCTION** LED should turn off. If the read right (frequency) display choice is selected, then the **SPCL FUNCTION** LED should turn on.

Serial Port header: GPREAD

3.8.6 SELECTING SRQ CONDITIONS

DESCRIPTION

If the instrument is configured to respond to a serial poll from the remote controller, it will issue a Request for Service whenever any of the selected conditions is in effect. When polled it responds with the Status Byte configured as follows:

b6	set
b0	set, if data ready
b1	set, if GPIB command input error detected
b2	set, if fatal error in effect

The instrument will always request service when a GPIB data input error is detected. The data ready condition is true if measurement data, including floating point results and non-fatal measurement errors or exceptions, is available for output and depends on which display has been selected for reading to the GPIB. Refer to 3.8.1 and 3.8.5.

PROCEDURE

CHOICES	FRONT PANEL	SERIAL	GPIB
GPIB input error only	22.0 **SPCL**	22.0 SP	22.0SP
Fatal error	22.1 **SPCL**	22.1 SP	22.1SP
Fatal error or data ready	22.2 **SPCL**	22.2 SP	22.2SP

Note that GPIB command input error is a fatal error.

DEFAULT SETTING

Request service only when GPIB command input error detected.

ANNUNCIATION

If no other special functions are in effect, and the "Only on GPIB Error" option is selected, then the **SPCL FUNCTION** LED should turn off; if any of the other options are selected, the **SPCL FUNCTION** LED should turn on.

Serial Port header: SRQST

NOTES

The conditions which will cause the instrument to assert SRQ are not maintained through power down as they are considered part of the communications status and subject to external control. The default state can also be achieved by sending the instrument a SDC or DCL message.

3.8.7 DEVICE ADDRESS & TALK/LISTEN STATUS CONFIGURATION

DESCRIPTION

Selects new GPIB address, in the range of 0 to 31, and new Talk and Listen status. In either case, the GPIB device descriptor is modified and saved in non-volatile RAM. The new GPIB status will not come into effect until the next time an attempt is made to open a path to the GPIB device i.e., next power-up. Refer to Section 3.8.1.

PROCEDURE

Special Function 33 specifies the new device address as its suffix (decimal) while Special Function 34 suffix specifies the new talk/listen configuration.

CHOICES	FRONT PANEL	SERIAL	GPIB
Set addr (e.g. 25)	33.25 **SPCL**	33.25 SP	33.25SP
Select talk/listen configuration			
Talk and Listen	34.0 **SPCL**	34.0 SP	34.0SP
Listen Only	34.1 **SPCL**	34.1 SP	34.1SP
Talk Only	34.2 **SPCL**	34.2 SP	34.2SP

DEFAULT SETTING

Device address = 28 and Talk and Listen status i.e., normal mode.

ANNUNCIATION

The current GPIB address and operating mode may be displayed on the Front Panel amplitude (left) display by entering Special Function 21 or the -GPIB- **ID?** key. If the GPIB interface is installed, the display takes the form: N - M
where N = Device Address and is an integer in the range 0 to 30 and M = Operating Mode:

= 1, interface in talk and listen mode

= 2, interface in talk only mode

= 3, interface in listen only mode

If the GPIB interface is not installed, the display will show "0-0."

Serial Port header: GPIBST

NOTES

Altering the device address or Talk/Listen configuration may alter the GPIB operating mode. Entering a new device address of 31 will always put the GPIB in "Interface Not Installed" mode, although it will be annunciated with an address of 0. Refer to Section 3.8.1 re: GPIB Operating Modes.

When the device address and Talk/Listen configuration are redefined, a new device descriptor module, B0, is created in non-volatile RAM. The old address or Talk/Listen configuration are replaced and the module's revision number incremented. From then on, at power up, the address and talk and listen status will be retrieved from the new module in non-volatile RAM.

Note that the codes used by the **ID?** key and Special Function 21 to display current GPIB operating mode are not the same as the codes used by Special Function 34 to enter new talk/listen configuration. Check the manual carefully when interpreting status or changing it.

In this implementation of the GPIB interface, the manual switches for device address, LON and TON status required by the standard are replaced by Special Functions 33, 34 and their respective bits in the device descriptor and non-volatile RAM.

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3.9 SERIAL PORT INFORMATION
(requires option 232)

3.9.1 SERIAL PORT USAGE

The Amber Model 5500 is optionally provided with an asynch serial port which may be used to monitor the status of the instrument and to send it control information. The most common use of this feature is to view the instrument status on a video terminal but it may also be used to operate the instrument from a host computer. For the latter application it will be necessary to extract the desired information from the output data stream. All of the data messages have a "lead-in" sequence which is used to position the cursor on a specific type of CRT (Lear Siegler ADM5 or Qume QVT 102), but may be used to identify a particular message. The actual data messages are preceded by a title or header which is useful for viewing on a "live" CRT but is of little use when connected to a host computer. In general, it will be possible to monitor the output data stream and synchronize string matches to the occurrence of the first two characters in any lead-in sequence (i.e., hex - 1B, 3D). The data may be identified by the two characters which follow these universal ones.

It is important to note that the instrument does not automatically output information to the serial port. Invoking special function 38.1 will enable the output data stream and 38.0 will disable it. At any time that this special function is called, the instrument will send a "clear screen" character (i.e., hex - 1A). Also note that the command input characters are echoed back to the host but the instrument will precede them with a lead-in sequence that would have them appear at the appropriate place on the command line. Thus some care must be taken to avoid interpreting these echoed characters as data. In general, the software will accept upper and lower case alpha characters on the command line but will only output upper case except when echoing input. The command line is carriage return driven so that it is possible to use the backspace key for rudimentary editing. The command line processor will not clear the line after entry to allow the user to view the last entry. If the previous entry was longer than the present one, some spurious characters will appear to follow it on the line. These characters will not be recognized by the software and can safely be ignored.

The additional burden imposed on the software by the serial output routines will slow the instrument down by approximately 50% in typical usage, more if large amounts of data are being transmitted. As mentioned in the hardware description of the serial interface, the system does not recognize the use of RTS or DTR to hold off input but uses the standard Xon-Xoff protocol to allow the host to throttle the output data stream. It will itself use this mechanism to avoid allowing the host to overrun the serial port input buffer. This means that the host must also support the protocol bidirectional. If the serial port is held off for a significant percentage of the time while the output is enabled, the instrument will appear to behave sluggishly and if the Xoff character is sent without being released by an Xon, the whole instrument will appear to stop. Sending the required Xon character at this point will generally restore proper operation.

The output of information to the serial port may be enabled or disabled from the front panel via the **SERIAL INTERFACE** key. If the serial port screen is currently enabled, closure of this key will clear the screen and disable the output data stream. If the serial port screen is currently disabled, closure of the **SERIAL INTERFACE** key will update the screen and enable the output data stream.

3.9.2 SERIAL PORT PARAMETERS

The serial port defaults to the following conditions on instrument power-up:

Baud rate - 9600
Data Bits - 8
Stop Bits - 1
Parity - none
Handshake - XOn-Xoff

While the above conditions are fixed in the 5500 internal firmware, the baud rate may be modified by the user (see below). Additionally, the rear panel interface module may be configured to be either DTE or DCE, conditional on the installation of jumpers as defined below.

3.9.3 AUTOMATIC BAUD RATE SETTING INFORMATION

Although the 5500 serial port is only specific for operation at 9600 baud, it is possible under certain circumstances to have it operate at certain other baud rates. If the software detects a received break condition it will attempt to adjust the 5500 baud rate to conform with that of the remote serial device. The algorithm used will not attempt to change the baud rate until three successive break conditions have been detected, and then will cycle through its allowed baud rates on successive breaks until a confirmation is received. The software will set a new baud rate and output the string (enter carriage return to confirm baud rate), and wait for a response. If the received character is indeed a carriage return, the baud rate is fixed at a current value and control is returned to the applications program; any other response will cause it to try another baud rate. The allowed baud rates are as follows: 300, 600, 1200, 2400, 4800, 9600, 19.2 k.

Note that the default conditions, including the 9600 baud rate, are restored at instrument power-up. If an alternate baud rate is required, the above procedure must be followed after each power-up.

3.9.4 SERIAL PORT OUTPUT DATA FORMAT

All lead-in data in hexadecimal

The following information is organized in the same order that the commands are listed in the first sections of the manual where possible.

Function: Input select
Header String: INSEL:
Header Lead-in: 1B, 3D, 21, 20
Data: A, B, AOUT, or BOUT
Data Lead-in: 1B, 3D, 22, 20
References: 3.2.1

Function: Input termination
Header String: INPZ:
Header Lead-in: 1B, 3D, 30, 48
Data: HIZ, 150, 600
Data Lead-in: 1B, 3D, 31, 48
References: 3.2.2, 3.4.1 and 3.5.6

Function: PGA operating mode
Header String: PGAMD:
Header Lead-in: 1B, 3D, 21, 28
Data: AUTO or HOLD
Data Lead-in: 1B, 3D, 22, 28
References: 3.2.5, 3.2.3 and 3.2.4

Function: PGA status
Header String: PGASTS:
Header Lead-in: 1B, 3D, 21, 30
Data: -30 DB to +35 DB (in 5 dB steps)
Data Lead-in: 1B, 3D, 22, 30
References: 3.2.5, 3.2.3 and 3.2.4

Function: PGB operating mode
Header String: PGBMD:
Header Lead-in: 1B, 3D, 21, 58
Data: AUTO or HOLD
Data Lead-in: 1B, 3D, 22, 58
References: 3.2.6, 3.2.3 and 3.2.4

Function: PGB status
Header String: PGBSTS:
Header Lead-in: 1B, 3D, 21, 60
Data: 0 DB to +80 DB (in 20 dB steps)
Data Lead-in: 1B, 3D, 22, 60
References: 3.2.6, 3.2.3 and 3.2.4

Function: Programmed SVF frequency
Header String: SVFFRQ:
Header Lead-in: 1B, 3D, 21, 38
Data: 9.5000 HZ to 105.00 KHZ
Data Lead-in: 1B, 3D, 22, 38
References: 3.2.7, 3.2.9, 3.3.1 and 3.4.3

Function: Programmed SVF frequency increment
Header String: SVFINC:
Header Lead-in: 1B, 3D, 27, 60
Data: 0.0000 HZ to 100.00 KHZ (or 0 % to many %)
Data Lead-in: 1B, 3D, 28, 60
References: 3.2.8

Function: SVF tuning mode
Header String: TUNMD:
Header Lead-in: 1B, 3D, 24, 58
Data: AUTO or HOLD
Data Lead-in: 1B, 3D, 25, 58
References: 3.2.9, 3.2.3, 3.2.4 and 3.3.1

Function: Servo status
Header String: SERVO:
Header Lead-in: 1B, 3D, 21, 48
Data: OFF or ON
Data Lead-in: 1B, 3D, 22, 48
References: 3.2.9 and 3.3.1

Function: Weighting filter selected
Header String: FILSEL:
Header Lead-in: 1B, 3D, 21, 68
Data: OFF,30K,80K,SPCL,SP0,SP1,SP2,SP3
Data Lead-in: 1B, 3D, 22, 68
References: 3.2.10

Function: High pass filter state
Header String: HPFIL:
Header Lead-in: 1B, 3D, 24, 20
Data: OFF or ON
Data Lead-in: 1B, 3D, 25, 20
References: 3.2.11

Function: PGC operating mode
Header String: PGCMD:
Header Lead-in: 1B, 3D, 24, 30
Data: AUTO or HOLD
Data Lead-in: 1B, 3D, 25, 30
References: 3.2.12, 3.2.3 and 3.2.4

Function: PGC status
Header String: PGCSTS:
Header Lead-in: 1B, 3D, 24, 38
Data: 0 DB to 20 DB (in 10 dB steps)
Data Lead-in: 1B, 3D, 25, 38
References: 3.2.12, 3.2.3 and 3.2.4

Function: Detector type
Header String: DETSEL:
Header Lead-in: 1B, 3D, 24, 40
Data: RMS,AVE,QPK
Data Lead-in: 1B, 3D, 25, 40
References: 3.2.13

Function: Detector speed (RMS)
Header String: DETSPD:
Header Lead-in: 1B, 3D, 24, 48
Data: VFAST,FAST,SLOW,VSLOW
Data Lead-in: 1B, 3D, 25, 48
References: 3.2.14, 3.2.3 and 3.2.4

Function: Detector operating mode (RMS)
Header String: DETMD:
Header Lead-in: 1B, 3D, 24, 50
Data: AUTO or HOLD
Data Lead-in: 1B, 3D, 25, 50
References: 3.2.14, 3.2.3 and 3.2.4

Function: Measurement type
Header String: AMPMSM:
Header Lead-in: 1B, 3D, 21, 50
Data: WB,BPVW,BPW,BPM,BPN,HP,LP,THD,THDL,CCIF,SMPTE
Data Lead-in: 1B, 3D, 22, 50
References: 3.3.1

Function: Measurement mode
Header String: MSMODE:
Header Lead-in: 1B, 3D, 2D, 28
Data: RUN,HOLD,TRIG,TRIGWS
Data Lead-in: 1B, 3D, 2E, 28
References: 3.3.2

Function: Measurement sync
Header String: FRQMSM:
Header Lead-in: 1B, 3D, 24, 60
Data: IN or OSC
Data Lead-in: 1B, 3D, 25, 60
References: 3.3.1, 3.10.1 to 3.10.7

Function: Programmed source amplitude
Header String: SRCAMP:
Header Lead-in: 1B, 3D, 27, 20
Data: 0.0000 V to 33.000 V or dBV or dBm equiv.
Data Lead-in: 1B, 3D, 28, 20
References: 3.4.1, 3.5.6, 3.2.2 and 3.4.9

Function: Programmed source amplitude increment
Header String: AMPINC:
Header Lead-in: 1B, 3D, 27, 40
Data: 0.0000 V to 33.000 V (or % or dB)
Data Lead-in: 1B, 3D, 28, 40
References: 3.4.2, 3.5.6 and 3.2.2

Function: Programmed source frequency
Header String: SRCFRQ:
Header Lead-in: 1B, 3D, 27, 30
Data: 10.000 HZ to 100.00 KHZ
Data Lead-in: 1B, 3D, 28. 30
References: 3.4.3, 3.3.1 and 3.2.7

Function: Programmed source frequency increment
Header String: FRQINC:
Header Lead-in: 1B, 3D, 27, 50
Data: 0.0000 HZ to 100.00 KHZ (or 0 % to many %)
Data Lead-in: 1B, 3D, 28, 50
References: 3.4.4

Function: Programmed IMD offset frequency
Header String: IMFREQ:
Header Lead-in: 1B, 3D, 30, 38
Data: 40 HZ to 500 HZ (at specified steps)
Data Lead-in: 1B, 3D, 31, 38
References: 3.4.5 and 3.3.1

Function: Programmed IMD mix ratio
Header String: IMDRAT:
Header Lead-in: 1B, 3D, 24, 28
Data: 1:1,1:2,1:4,1:10
Data Lead-in: 1B, 3D, 25, 28
References: 3.4.6 and 3.3.1

Function: Output enable
Header String: OUTPUT:
Header Lead-in: 1B, 3D, 30, 20
Data: OFF or ON
Data Lead-in: 1B, 3D, 31, 20
References: 3.4.7

Function: Output reference
Header String: OUTREF:
Header Lead-in: 1B, 3D, 30, 28
Data: GROUND,FLOAT
Data Lead-in: 1B, 3D, 31, 28
References: 3.4.8

Function: Output structure and impedance
Header String: OUTSTS:
Header Lead-in: 1B, 3D, 30, 30
Data: IMP600,IMP150,IMP50
Data Lead-in: 1B, 3D, 31, 30
References: 3.4.9 and 3.4.1

Function: Output load impedance reference, level
Header String: OIRL:
Header Lead-in: 1B, 3D, 30, 50
Data: 1 OHM to 9999 OHM
Data Lead-in: 1B, 3D, 31, 50
References: 3.4.10

Function: Output load impedance reference, power
Header String: OIRP:
Header Lead-in: 1B, 3D, 30, 60
Data: 1 OHM to 9999 OHM
Data Lead-in: 1B, 3D, 31, 60
References: 3.4.10

Function: Output configuration
Header String: OUTCNF:
Header Lead-in: 1B, 3D, 2D, 60
Data: A, B, A & B, or A& -B
Data Lead-in: 1B, 3D, 2E, 60
References: 3.4.11

Function: Relative mode
Header String: RATIO:
Header Lead-in: 1B, 3D, 2D, 30
Data: OFF or ON
Data Lead-in: 1B, 3D, 2E, 30
References: 3.5.1 and 3.5.2

Function: Distortion ratio reference
Header String: DSTREF:
Header Lead-in: 1B, 3D, 2A, 40
Data: 0 % to many % (or log equivalent)
Data Lead-in: 1B, 3D, 2B, 40
References: 3.5.2 and 3.5.1

Function: Level ratio reference
Header String: LVLREF:
Header Lead-in: 1B, 3D, 2A, 50
Data: 0.0000 V to many V (or dBv or dBm equivalent)
Data Lead-in: 1B, 3D, 2B, 50
References: 3.5.2 and 3.5.1

Function: Amplitude units operating mode
Header String: AUNITS:
Header Lead-in: 1B, 3D, 2A, 60
Data: FLOAT or FIXED
Data Lead-in: 1B, 3D, 2B, 60
References: 3.5.4

Function: Amplitude units decimal point mode
Header String: ADPNT:
Header Lead-in: 1B, 3D, 2A, 68
Data: FLOAT or FIXED
Data Lead-in: 1B, 3D, 2B, 68
References: 3.5.5

Function: Watts reference impedance
Header String: WTSIMP:
Header Lead-in: 1B, 3D, 2A, 20
Data: 0 OHM to 999 OHM
Data Lead-in: 1B, 3D, 2B, 20
References: 3.5.6

Function: dBm reference impedance
Header String: DBMIMP:
Header Lead-in: 1B, 3D, 2A,30
Data: 0 OHM to 999 OHM
Data Lead-in: 1B, 3D, 2B, 30
References: 3.5.6, 3.2.2 and 3.4.1

Function: Frequency display decimal point mode
Header String: FDPNT:
Header Lead-in: 1B, 3D, 2D, 20
Data: FLOAT or FIXED
Data Lead-in: 1B, 3D, 2E, 20
References: 3.5.7

Function: Numeric entry mode
Header String: NMODE:
Header Lead-in: 1B, 3D, 2D, 38
Data: SRCAMP, SRCFRQ, IMFREQ, REF, AMPINC, FRQINC
Data Lead-in: 1B, 3D, 2E, 38
References: 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5, 3.5.2

Function: Front panel status (re: GPIB)
Header String: FPANEL:
Header Lead-in: 1B, 3D, 2D, 40
Data: LOCS, LWLS, REMS, RWLS
Data Lead-in: 1B, 3D, 2E, 40
References: 3.8.1 and 3.8.2

Function: Display selected for GPIB read
Header String: GPREAD:
Header Lead-in: 1B, 3D, 2D, 48
Data: LEFT or RIGHT
Data Lead-in: 1B, 3D, 2E, 48
References: 3.8.5 and 3.8.1

Function: Conditions to set SRQ on GPIB
Header String: SRQST:
Header Lead-in: 1B, 3D, 2D, 50
Data: GPERR,DRDY,FTLERR
Data Lead-in: 1B, 3D, 2E, 50
References: 3.8.6 and 3.8.1

Function: GPIB configuration
Header String: GPIBST:
Header Lead-in: 1B, 3D, 2E, 58
Data: 1-0 to 3-31
Data Lead-in: 1B, 3D, 2D, 58
References: 3.8.7, 3.8.1

Function: DC scale
Header String: DCSCL:
Header Lead-in: 1B, 3D, 24, 68
Data: 100V, 10V, 1V
Data Lead-in: 1B, 3D, 25, 68
References: X.2.17, X.3.4

Function: Phase scale
Header String: PZSCL:
Header Lead-in: 1B, 3D, 2D, 68
Data: ± 180 or 0-360
Data Lead-in: 1B, 3D, 2E, 68
References: X.2.17, X.3.5

Function: DC Volts & Phase measurement
Header String: DCMODE:
Header Lead-in: 1B, 3D, 33,68
Data: OFF, DC, or PZ
Data Lead-in: 1B, 3D, 34, 68
References: X.3.4

Function: Last measured amplitude or distortion
Header String: AMP:
Header Lead-in: 1B, 3D, 33, 20
Data: actual data
Data Lead-in: 1B, 3D, 34, 20
References:

Function: Last measured frequency
Header String: FRO:
Header Lead-in: 1B, 3D, 33, 30
Data: actual data
Data Lead-in: 1B, 3D, 34, 30
References:

Function: Amplitude or distortion measurement status
Header String: AMPSTS:
Header Lead-in: 1B, 3D, 33, 40
Data: if no error or exception, null, else error number
Data Lead-in: 1B, 3D, 34, 40
References: see error and exception definitions

Function: Frequency measurement status
Header String: FRQSTS:
Header Lead-in: 1B, 3D, 33, 48
Data: if no error or exception, null, else error number
Data Lead-in: 1B, 3D, 34, 48
References: see error and exception definitions

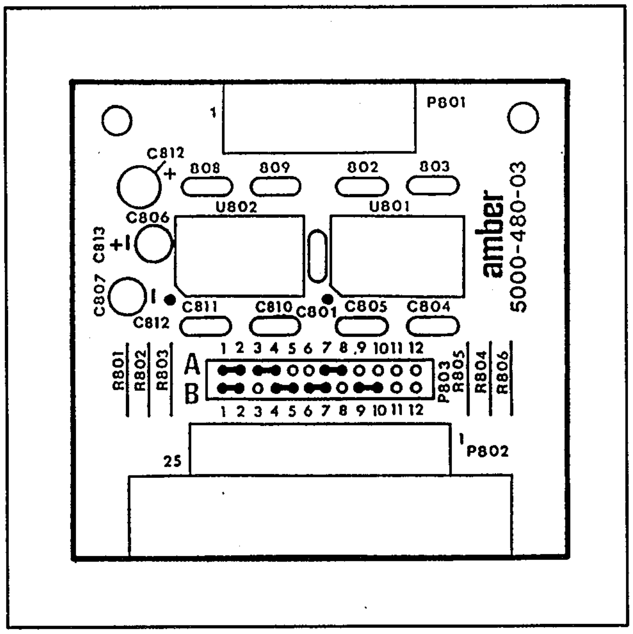
Function: Fatal error status
Header String: FLTERR:
Header Lead-in: 1B, 3D, 33, 50
Data: if no error, null, else error number
Data Lead-in: 1B, 3D, 34, 50
References: see error and exception definitions

Function: Input prompt
Header String: ENTER:
Header Lead-in: 1B, 3D, 36, 20
Data: echoes input characters
Data Lead-in: 1B, 3D, 36, 27-40
References: see command definitions

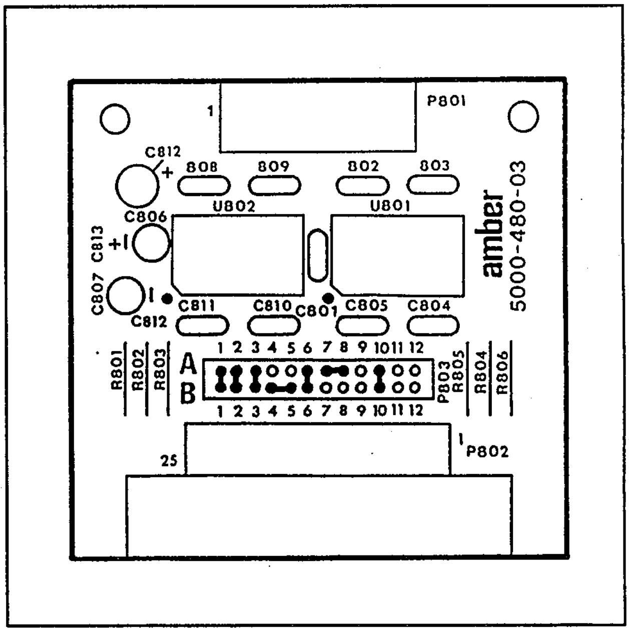
3.9.5 CONFIGURATION JUMPERS FOR RS 232-C INTERFACE BOARD

The serial interface board can be configured to act as either DTE or DCE. The current implementation of the device driver will set those control lines which an external device may require but ignore the lack of return control signals from an external device. Thus an external device cannot expect to hold off input by (illegally) forcing DTR to a false state as is done by some printers. The correct method for holding off input is by using the Xon-Xoff protocol, which is completely supported by the driver. The standard configurations for the serial port (P2 on the CPU) is as DCE. If the system must communicate with another which is also configured as DCE, it is simple to reconfigure the jumpers on the board to act as DTE.

The following diagrams represent the component side view of the interface board viewed with the external DB-25 connector down and show the jumpers that are usually installed on the 24 pin header.



Configured as DCE



Configured as DTE

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3.10 ERROR DEFINITIONS

3.10.1 MEASUREMENT EXCEPTIONS

Exceptions indicate any of a number of largely transitory conditions that can occur during measurement which cause it to be aborted. They are non-fatal in that they don't inhibit measurement and are automatically cleared by subsequent measurements. Exception occurrences are counted. In the case of auto-ranging exceptions, if consecutive measurements are aborted due to both over and under range conditions, and 3 over range exceptions as well as 3 under range exceptions have been counted, the exception counters are cleared and measurement error 24 is generated. In the case of exception 17, after 3 consecutive occurrences, measurement error 25 will be generated and the exception counters cleared. Note that any time instrument status is modified, the exception counters are cleared.

SERIAL PORT ANNUNCIATION

Exception codes are always displayed under AMPSTS along with the incomplete amplitude or distortion readings (under AMP) produced by the aborted measurement.

GPIB ANNUNCIATION

If the instrument is enabled to send amplitude or distortion results over the GPIB interface and measurement is aborted due to an exception, the exception code, in standard GPIB error format, will be sent instead of amplitude or distortion readings. If the SRQ "data available" condition is enabled, a request for service is issued and the status byte's data available bit is set.

FRONT PANEL ANNUNCIATION

Exception codes are not displayed on the front panel. On the first three occurrences of a particular exception, the front panel amplitude display will not be updated; subsequent occurrences will cause dashes to be displayed.

EXCEPTION CODES

11 Signal at PGAout over range:
PGA gain decremented

12 Signal at PGAout under range:
PGA gain incremented

13 Signal at PGBout over range:
PGB gain decremented

14 Signal at PGBout under range:
PGB gain incremented

15 Signal at PGCout over range:
PGC gain decremented

16 Signal at PGCout under range:
PGC gain incremented

17 SVF not tuned to input signal:
SVF frequency adjusted

If PGA, PGB, PGC or SVF tuning operating modes are not auto or if gain settings are at their minimum or maximum level and can't be further adjusted, the corresponding exceptions won't be generated although a number of measurement errors may (see 3.10.2 below). For a more detailed description of the conditions under which these exceptions will be generated, refer to the individual measurement descriptions in Section 3.10.

3.10.2 MEASUREMENT ERRORS

As with measurement exceptions, measurement errors indicate any of a number of conditions that can occur during measurement which cause it to be aborted. The conditions that generate these errors are not generally considered transient and will, if they persist, cause the instrument to enter a fatal error state. Measurement errors are initially non-fatal, i.e. they are automatically cleared by subsequent measurements. If, however, 128 consecutive measurements are aborted due to the same error, it becomes fatal and further measurement is inhibited until the error is cleared. If at any time instrument status is altered, the measurement error count is automatically reset to 0. A fatal error condition may be cleared by the CLEAR command (refer to 3.6.1); once cleared, the instrument will resume measurement.

SERIAL PORT ANNUNCIATION (requires option 232)

If the error is non-fatal, the error code is always displayed under AMPSTS along with the incomplete amplitude or distortion readings (under AMP); if the error is fatal, the error code is displayed under FTLERR.

GPIB ANNUNCIATION

If the instrument is enabled to send amplitude or distortion results over the GPIB interface and a non-fatal measurement error is generated, the error code, in standard GPIB error format, will be sent instead of amplitude or distortion readings. A fatal error, regardless of which display is selected for reading to the GPIB, will always be sent if the instrument is enabled to send data. If the SRQ "data available" condition is enabled and a non-fatal error occurs, a request for service will be issued and the data available bit of the status byte set; if a fatal error occurs, SRQ will be issued if the SRQ "fatal error" condition is enabled and in this case, the fatal error bit of the status byte will be set.

FRONT PANEL ANNUNCIATION

The first three occurrences of a non-fatal error will cause dashes to be displayed on the appropriate front panel display. The actual error code will be displayed on subsequent occurrences. In the case of fatal measurement error, the error code will be displayed on both front panel displays.

MEASUREMENT ERROR CODES

Error 20 Signal at PGAout over range and PGA gain/attenuation level can't be adjusted, either because PGA operating mode is in hold or the attenuation level is already at its maximum setting. This error will occur during distortion type measurement, and during BP level type measurement if SVF tuning is enabled, when the signal at PGAout is either over range or significantly over range. During level type measurements, if SVF tuning is disabled, this error will occur only if the signal at PGAout is significantly over range.

Error 21 Signal at PGAout under range and PGA gain/attenuation level can't be adjusted, either because PGA operating mode is in hold or the current gain level is already at its maximum setting. This error will only occur during distortion type measurement, and during BP level type measurement if SVF tuning is enabled, if the signal at PGAout is either over range or significantly over range.

Error 22 Signal at PGBout over range and PGB gain level can't be adjusted either because PGB operating mode is in hold or current PGB gain level is already at its minimum setting. This error occurs only if the signal at PGBout is significantly over range.

Error 24 Signal at PGCout over range and PGC gain level can't be adjusted either because PGC operating mode is in hold or current PGC gain level is already at its minimum setting. This error occurs only if the signal at PGCout is significantly over range.

Error 26 Signal frequency is out of range. This error will occur only during THD or BP type measurement if SVF tuning is enabled and the sampled signal frequency is outside the range of 9.5 Hz and 105 kHz.

Error 27 Can't tune SVF due to lack of frequency reading. Again this error will only occur during THD or BP type measurement if SVF tuning is enabled. It is generated if frequency measurement of the signal at PGAout with the sampling interval set to 10 ms is still incomplete after a 250 ms interval.

Error 28 Can't measure distortion due to lack of hardware sync'd amplitude reading of the signal at PGAout or, in the case of IMD* type measurement, the signal chosen for sync (either recovered LF or LF oscillator) is not available. This error will be generated if the hardware sync'd amplitude measurement with the sampling interval set to 10 ms is still incomplete after 250 ms.

Error 29 IMD* mix mismatch. This error will only be generated during IMD SMPTE type measurement if the sampled signal at the recovered HF is outside the range of 1 to 4 V.
*IMD Function requires option 002.

Error 30 Level calculation overflow. This error indicates that an overflow condition was detected at measurement time either during auto-ranging or level reading but prior to any distortion or display calculations. May also be caused by DC inputs too negative.

***IMD Function requires option 002.**

Error 31 Can't tune SVF due to frequency counter overflow. This error will only occur during THD or BP type measurement if SVF tuning is enabled. It is generated if an overflow condition is detected during frequency measurement of the signal at PGAout with the sampling interval set to 10 ms.

Error 32 DC level calculation overflow. Caused by DC inputs too positive. (Requires option 008.)

Error 34 Can't auto-range due to instability of input signal. This error will be generated if consecutive attempts at auto-ranging vacillate between under range and over range. Refer to 3.10.1 for a more precise description of the conditions under which this error will be generated.

Error 35 Can't tune SVF due to instability of input signal. This error will be generated if the SVF frequency is still not tuned to signal frequency, at PGAout, after 3 consecutive attempts to tune the filter. Refer to 3.10.1 for additional mention.

Error 37 Level calculation underflow. This error indicates that zero results or an underflow condition was detected at measurement time either during auto-ranging or level reading but prior to any distortion or display calculations.

Error 38 Distortion calculation underflow. This error can only occur if the low resolution reading of the signal amplitude at PGAout returns a zero or underflow result.

Error 39 Ratio calculation underflow. This error may be produced by an underflow error returned by the math package when calculating the ratio from level or distortion to the reference value.

Error 40 Ratio calculation overflow. This error may be produced by an overflow error returned by the math package when calculating the ratio from level or distortion to the reference value.

Error 41 Distortion calculation overflow. This error can only occur if, after auto-ranging is completed, the hi resolution reading of the signal amplitude at the selected detector returns a zero or underflow result.

Error 42 Level/distortion display overflow. This error indicates that measurement data doesn't fit the current display format and will only occur if amplitude units or decimal point position are being held.

Error 44 Measurement readings lost. This error indicates that low level hardware sync'd or software sync'd measurement data has been lost and measurement must be restarted.

Error 47 Can't get frequency reading. This error will occur if the hi resolution frequency reading with sampling interval specified at 50 ms is still incomplete after 250 ms.

Error 49 Frequency calculation overflow. This error will occur at measurement time if the hi resolution frequency reading, with sampling interval set to 50 ms, overflows.

Error 50 Frequency display overflow. This error indicates that frequency measurement data doesn't fit the current display format and will only occur if decimal point position is being held.

Note that display underflow will not generate an error. If measurement data doesn't fit the current display format because units or decimal point position is being held, 0.0 will be displayed.

Error 60 AUTOCAL failure. Indicates a hardware failure preventing the successful completion of an automatic calibrate sequence.

Error 99 ROM failure. This indicates a failure to complete the self- check sequence at instrument power-up.

3.10.3 COMMAND INPUT ERRORS

Input errors indicate invalid input command mnemonics, operands and numeric string entry. They are always fatal, i.e. measurement will be inhibited until the error is cleared via a CLEAR command (refer to 3.6.1).

SERIAL PORT ANNUNCIATION

The error code is always displayed under FTLERR.

GPIB ANNUNCIATION

A fatal error, regardless of which display is selected for reading to the GPIB, will always be sent if the instrument is enabled to send data. If the SRQ "fatal error" condition is enabled, a request for service will be issued and the fatal error bit of the status byte set.

FRONT PANEL ANNUNCIATION

The error code will be displayed on both front panel displays.

INPUT ERROR CODES

1 Invalid special function suffix

2 Unrecognized command

3 Invalid string character

4 Invalid numeric string

5 Invalid terminator

6 Invalid command operand

7 Operand out of range

8 Invalid special function prefix

9 GPIB input code error

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3.11 TABLES

3.11.1 SERIAL PORT COMMANDS

MNEMONIC	DESCRIPTION	REFERENCES
AMPFRMT	Select amplitude display units	3.5.4
AMPINC	Select source amplitude increment	3.4.2
AMPMSM	Select measurement type	3.3.1
AMPUNIT	Select amplitude display units	3.5.3, 3.5.4
AUTO	Select automatic operation	3.2.3
CLEAR	Clear front panel displays or trigger measurement in hold or triggered mode	3.6.1, 3.8.4
DBMIMP	Select dBm impedance reference	3.5.6
DC	DC Volts measurement mode	3.2.16
DETSEL	Select detectors	3.2.13
DETSPD	Select detector speed	3.2.14
DOWN	Decrement currently selected parameter	3.1.5
DUP	Set currently selected parameter to last measurement result	3.1.5
FILSEL	Select weighting filters	3.2.10
FRQDPNT	Select frequency display decimal point position	3.5.7
FRQINC	Select source frequency increment	3.4.4

MNEMONIC	DESCRIPTION	REFERENCES
FRQMSM	Select measurement synch	3.3.3
HOLD	Select hold settings operating mode	3.2.4
HPFIL	Enable or disable high pass filter	3.2.11
IMFREQ	Select IMD offset frequency	3.1.5, 3.4.5
INPZSEL	Select input termination	3.2.2
INSEL	Select input source	3.2.1
LIN	Select linear amplitude display units	3.5.3
LOG	Select log amplitude display units	3.5.3
OUTCNF	Select output configuration	3.4.11
OUTENBL	Enable or disable output	3.4.7
OUTIMP	Select output structure	3.4.9
OUTREF	Select output reference	3.4.8
PGA	Select PGA operating mode and level	3.2.5
PGB	Select PGB operating mode and level	3.2.6
PGC	Select PGC operating mode and level	3.2.12
PZ	Phase measurement mode	3.2.19
RATIO	Enable or disable relative mode, select reference	3.5.1, 3.5.2
RECDFLT	Recall default machine state	3.7.3
RECFULL	Recall full machine state	3.7.3
RECPART	Recall partial machine state	3.7.2

MNEMONIC	DESCRIPTION	REFERENCES
REF	Select relative reference	3.1.5, 3.5.2
SRCAMP	Select source amplitude	3.1.5, 3.4.1
SRCFRQ	Select source frequency	3.1.5, 3.4.3
STORE	Store full machine state	3.7.1
SVFINC	Select SVF frequency increment	3.1.5, 3.2.8
SVFFRQ	Select SVF frequency	3.1.5, 3.2.7
TRACK	Select SVF tuning mode for BP type measurement	3.2.9
TUNE	Select SVF tuning mode for THD type measurement	3.2.9
UP	Increment currently selected parameter	3.1.5
WTSIMP	Select Watts impedance reference	3.5.6

3.11.2 GPIB COMMANDS

MNEMONIC	DESCRIPTION	REFERENCES
AN	Select source amplitude increment	3.1.5, 3.4.2
AP	Select source amplitude	3.1.5, 3.4.1
AU	Select automatic operation	3.2.3
BM	Select dBm amplitude display units	3.5.3, 3.5.4
BO	Select input, B output (requires option 007)	3.2.1
BV	Select dBV amplitude display units	3.5.3, 3.5.4
C0	Select A only output configuration	3.4.11
C1	Select B only output configuration (requires option 007)	3.4.11
C2	Select A & B output configuration (requires option 007)	3.4.11
C3	Select A & -B output configuration (requires option 007)	3.4.11
CL	Clear displays, trigger measurement for hold or trigger measurement modes	3.6.1, 3.8.4
D0	Select RMS detector	3.2.13
D1	Select Absolute Value detector	3.2.13
D2	Select Quasi-peak detector	3.2.13
DC	Enable DC Volts measurement (requires option 008)	3.2.16
DN	Decrement currently selected parameter	3.1.5
FI	Select input measurement sync	3.3.3

MNEMONIC	DESCRIPTION	REFERENCES
FN	Select source frequency increment	3.1.5, 3.4.4
FO	Select main oscillator measurement sync	3.3.3
FR	Select source frequency	3.1.5, 3.4.3
H0	Enable high pass filter	3.2.11
H1	Disable high pass filter	3.2.11
IA	Select input A	3.2.1
IB	Select input B	3.2.1
IF	Select IMD offset frequency (requires 002)	3.4.5
IO	Select input, A output	3.2.1
L0	Disable weighting filters	3.2.10
L1	Enable 30k LP filter	3.2.10
L2	Enable 80k LP filter	3.2.10
L3	Enable SPCL filter	3.2.10
L4	Enable Auxiliary Filter 1 (requires option 005 or 006)	3.2.10
L5	Enable Auxiliary Filter 2 (requires option 005 or 006)	3.2.10
L6	Enable Auxiliary Filter 3 (requires option 005 or 006)	3.2.10
L7	Enable Auxiliary Filter 4 (requires option 005 or 006)	3.2.10
LG	Select log amplitude display units	3.5.3

MNEMONIC	DESCRIPTION	REFERENCES
LN	Select linear amplitude display units	3.5.3
M1	Select wide band level measurement type	3.3.1
M3	Select THD level measurement type	3.3.1
M4	Select very wide BP level measurement type	3.3.1
M5	Select wide BP level measurement type	3.3.1
M6	Select medium BP level measurement type	3.3.1
M7	Select narrow BP level measurement type	3.3.1
M8	Select HP level measurement type	3.3.1
M9	Select LP level measurement type	3.3.1
O0	Disable output	3.4.7
O1	Enable output	3.4.7
OG	Select ground output reference	3.4.8
OF	Select floating output reference	3.4.8
P0	Select balanced 600 Ohms output impedance	3.4.9
P1	Select balanced 150 Ohms output impedance	3.4.9
P2	Select unbalanced 50 Ohms output impedance	3.4.9
PZ	Enable Phase measurement (requires option 009)	3.2.19
R0	Disable relative mode	3.5.1
R1	Enable relative, use currently selected reference	3.5.1, 3.5.2
RC	Recall Instrument Setup	3.7.2, 3.7.3
RE	Select relative mode reference	3.1.5, 3.5.2

MNEMONIC	DESCRIPTION	REFERENCES
RL	Output frequency display measurement data to GPIB	3.8.5
RR	Output amplitude display measurement data to GPIB	3.8.5
S3	Select THD measurement	3.3.1
S4	Select IMD CCIF distortion measurement (requires option 002)	3.3.1
S5	Select IMD SMPTE distortion measurement (requires option 002)	3.3.1
SF	Select SVF frequency	3.1.5, 3.2.7
SN	Select SVF frequency increment	3.1.5, 3.2.8
SP	Special Function	3.1.4
ST	Store Instrument Setup	3.7.1
T0	Select free-run measurement mode	3.3.2
T1	Select hold measurement mode	3.3.2
T2	Select trigger immediate measurement mode	3.3.2
T3	Select trigger with settling measurement mode	3.3.2
UP	Increment currently selected parameter	3.1.5
VO	Select V amplitude display units	3.5.3, 3.5.4
WA	Select W amplitude display units	3.5.3, 3.5.4
Z0	Select 100k Ohms input termination	3.2.2
Z1	Select 150 Ohms input termination	3.2.2
Z2	Select 600 Ohms input termination	3.2.2

3.11.3 SPECIAL FUNCTIONS

#	DESCRIPTION	REFERENCES
1	Select PGA operating mode and level	3.2.5
2	Select DC range	3.2.17
3	Select PGB operating mode and level	3.2.6
4	Select level output load impedance reference	3.4.10
5	Select power output load impedance reference	3.4.10
6	Select SVF tuning mode re: THD measurement	3.2.9
7	Sweep functions	See 054 manual
8	Select phase scale (requires option 009)	3.2.20
9	Enable automatic or hold settings operating modes	3.2.3, 3.2.4
10	Display main source settings	3.6.3
11	Enable or disable relative mode, select or display relative references	3.5.1 3.6.3
12	Special source processing	See option 003
13	Oscillator fine tune	3.4.3
14	Power amp source select	3.4.12
15	Special option path select	See 054 manual
16	Special option DATA	See 054 manual
17	Future option	NA
18	Future option	NA
19	Future option	NA

#	DESCRIPTION	REFERENCES
20	Select left or right front panel display for output to GPIB	3.8.5
21	Display GPIB status	3.6.3, 3.8.7
22	Select GPIB SRQ conditions	3.8.6
23	Select power up machine state	3.7.4
24	Auto calibrate	3.2.15
25	Select or display Watts impedance reference	3.5.6
26	Select or display dBm impedance reference	3.5.6
27	Select PGC operating mode and level	3.2.12
28	Select SVF tracking mode re: BP measurement	3.2.9
29	Select detector speed operating mode and speed	3.2.14
30	Select amplitude display units operating mode and display units	3.5.3, 3.5.4
31	Select amplitude display decimal point position operating mode and position	3.5.5
32	Select frequency display decimal point position operating mode and position	3.5.7
33	Reconfigure GPIB address	3.8.7
34	Reconfigure GPIB talk and listen status	3.8.7
35	Select IMD mix ratio	3.4.6
36	Enable THD level type measurement	3.3.1
37	Select measurement sync	3.3.3
38	Enable or disable serial port screen display	3.9.1

#	DESCRIPTION	REFERENCES
85	DC feedback control	3.2.18
86	Utility DAC A	3.4.13
87	Utility DAC B	3.4.13
88	DC relay multiplexer	3.4.14
89	DC digital utility	3.4.15

3.11.4 DEFAULT STATES

PARAMETER	DEFAULT STATE
Detector Speed	SLOW
Detector Selected	RMS
HP Filter	OFF
Weighting Filters	OFF
Input Selected	A
Servo	OFF
PGA Gain/Attenuation	-35 dB
PGB Gain	0 dB
PGC Gain	0 dB
Input Termination	100 k Ohms
Output A	OFF
Output Reference	GROUND
Output Structure	600 Ohms (BAL)
Programmed Source Amplitude Units	V
Ouput Load Impedance Reference, Level	INFINITY
Ouput Load Impedance Reference, Power	600 Ohm
Source Amplitude	0.0 V
Source Frequency	1.0 kHz
SVF Frequency	1.0 kHz
IMD Offset Frequency	60 Hz
Distortion Reference	100.0 %
Level Reference	1.0 V
Source Amplitude Increment	1.0 V
Source Frequency Increment	1.0 Hz
SVF Frequency Increment	1.0 Hz
dBm Impedance	600 Ohms
Watts Impedance	8 Ohms
Operating Mode	AUTO
Amplitude Display Units	V
Amplitude Display Decimal Point Position	DDD.DD
Frequency Display Units	Hz

PARAMETER	DEFAULT STATE
Frequency Display Decimal Point Position	DDD.DD
Frequency Measurement Source	INPUT
Narrow Band Measurement Type	VERY WIDE BP
Front Panel Special Amplitude Display	OFF
Front Panel Special Frequency Display	OFF
Amplitude Display Units Operating Mode	FLOATING
Amplitude Display Decimal Operating Mode	FLOATING
Frequency Display Decimal Operating Mode	FLOATING
PGA Operating Mode	AUTO
PGB Operating Mode	AUTO
PGC Operating Mode	AUTO
SVF Tuning Mode	HOLD
Detector Speed Mode	AUTO
Numeric Entry Mode	SOURCE AMPLITUD
IMD Mix Ratio	1:1
Measurement Mode	FREE RUN
Relative Measurement Enable	OFF
Measurement Type	WIDE BAND
Output B	OFF
Power amp source select	INTERNAL
Absolute Units	V
Output Configuration	A ONLY
Output Enable	OFF
Programmed Source Amplitude	0.0 V
DC Range	100 V
Phase Scale	± +180
DC Volts Measurement Mode	OFF
Phase Measurement Mode	OFF
DC Feedback	FULL
DC DAC A	0
DC DAC A	0
DC Multiplexer	OUTPUTS OFF
DC Digital Utility	0